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Study of Concrete Mixers

Civil Engineering

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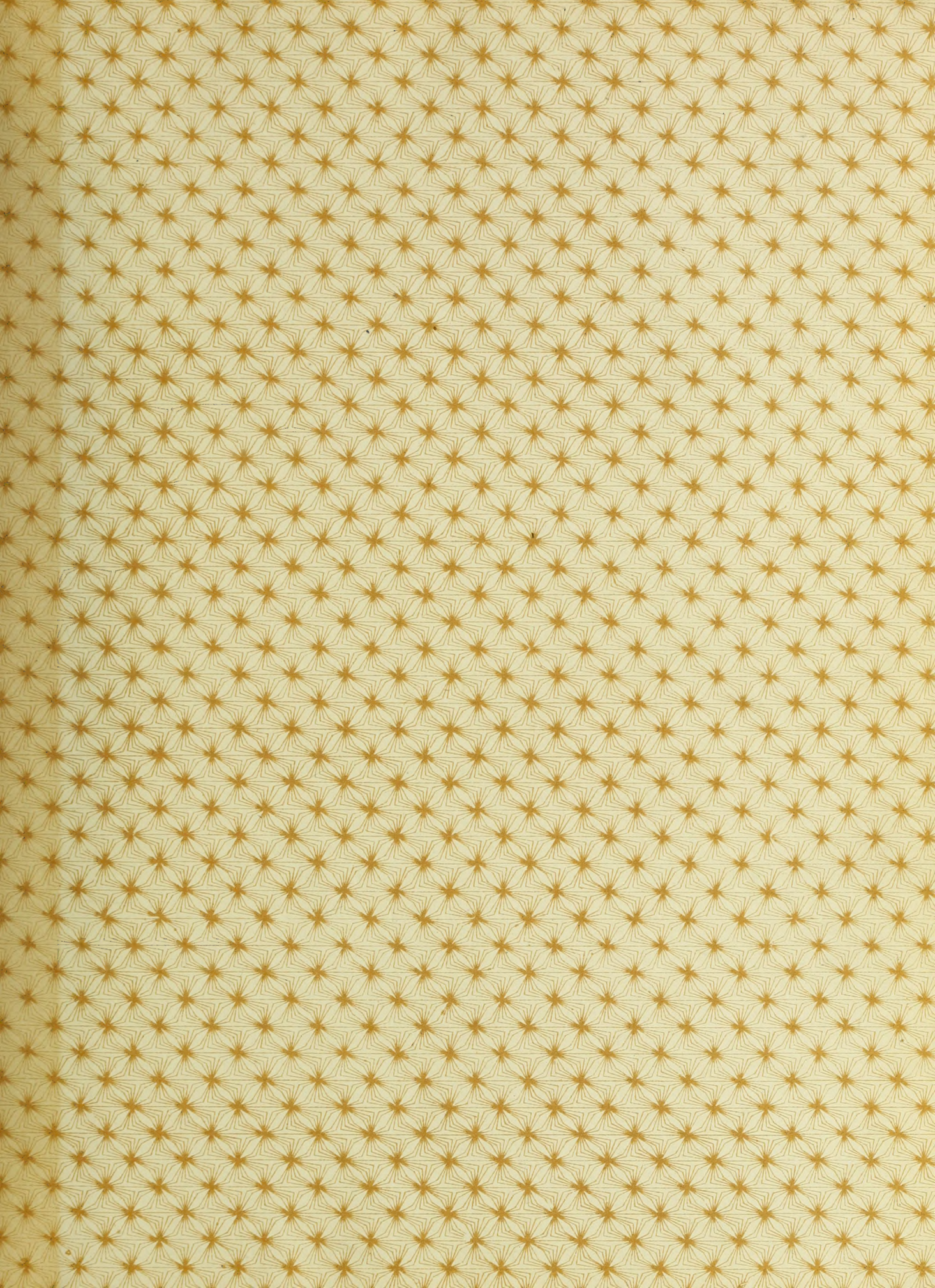


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**STUDY**  
**OF**  
**CONCRETE MIXERS**  
**BY**  
**ROBERT PAUL BATES**  
**THESIS**  
**FOR**  
**DEGREE OF BACHELOR OF SCIENCE**  
**IN**  
**CIVIL ENGINEERING**  

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**COLLEGE OF ENGINEERING**  
**UNIVERSITY OF ILLINOIS**  
**PRESENTED JUNE 1906**



STUDY

OF THE

CONCRETE MIXERS

AND THE

THEIR

THEORY OF THE MIXING OF CONCRETE

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THEORY OF THE MIXING OF CONCRETE



U N I V E R S I T Y   O F   I L L I N O I S

May 30, 1906

This is to certify that the thesis prepared under the  
immediate direction of Assistant Professor F. G. Frink by

ROBERT PAUL BATES

entitled


STUDY OF CONCRETE MIXERS

is approved by me as fulfilling this part of the requirements for  
the Degree of Bachelor of Science in Civil Engineering.

*Ira O Baker*

Head of Department of Civil Engineering





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# TABLE OF CONTENTS

	Page
<i>Introduction</i>	1
<i>Classification of Concrete Mixers</i>	4
<i>Type 1- Gravity Mixers</i>	
<i>Hains</i>	7
<i>Portable Gravity</i>	12
<i>Type 2- Horizontal Drum Mixers</i>	
<i>Smith</i>	18
<i>Ransome</i>	24
<i>Gotham</i>	29
<i>International</i>	31
<i>Steam Heated Batch</i>	34
<i>United</i>	36
<i>McKelvey Batch</i>	40
<i>McKelvey Continuous</i>	43
<i>Buffalo</i>	45
<i>Type 3- Oblong Box Mixers</i>	
<i>Cockburn Barrow &amp; Machine Co's. Mixer</i>	49
<i>Type 4 - Cubical Mixers</i>	
<i>Chicago Cube</i>	52
<i>Cockburn Barrow &amp; Machine Co's. Cubical</i>	55
<i>Type 5- Vertical Drum Mixers</i>	
<i>Campbell</i>	57
<i>Type 6 - Inclined Drum Mixers</i>	
<i>Snell</i>	61
<i>Page</i>	64
<i>Type 7- Oscillating Mixers</i>	
<i>Clover Leaf</i>	68
<i>Type 8- Pug-mill Mixers</i>	
<i>Foote</i>	70
<i>Drake</i>	74
<i>Connolly</i>	84
<i>American</i>	89
<i>Trump</i>	92
<i>Conclusion</i>	101







# STUDY OF CONCRETE MIXERS

## INTRODUCTION

It has been well said that "a chain is no stronger than its weakest link." At the present time concrete forms a very important link in Engineering construction - which is shown by the fact that 26,000,000 barrels of cement were manufactured in the United States in 1904, the great bulk of which was without doubt used for making concrete. But this link may indeed be very weak unless the concrete is properly made. And probably no other factor governs the quality of this material as does the mixing; for careful or careless mixing will alone decide whether it is to stand the test of time like adamant itself, or whether it is to crumble away before the persistent attack of the







elements. We must admit then that the mixing of concrete is a subject well worth our careful consideration.

There are two general methods by which this mixing may be done; by hand or by machinery. The first method is rapidly disappearing except for work of minor importance, but where used is carried on in the following manner: The ingredients are spread in layers upon a platform of wood or steel, and the mass is turned over and over with shovels. Water is then added, usually with a hand sprinkler, and the mixing is completed by further shoveling. During one summer vacation the writer worked as one of a gang of laborers mixing concrete in this way for use in bridge abutments. As a result of this experience he feels safe in making the statement that hand mixing is at best but an imperfect process. The quicker, more thorough and more economical method





is that which makes use of machinery; and it is in this way that the greater part of the concrete is mixed today. To make a study of the machines that are doing this work, is the object of this Thesis.

In gathering together the information that is here presented, the writer has had to depend largely upon the manufacturers of concrete mixers. But whenever possible he has visited machines in actual operation and has acquired facts both from the Engineers and inspectors in charge, and from the laborers employed on the work. Still other information has been secured from engineering periodicals. It is the intention of the Thesis to give a brief description and explanation of the principal mixers now on the market and at the close to draw some conclusions as to the subject in general.





## CLASSIFICATION OF CONCRETE MIXERS

All concrete mixers may be included under two general classes :

(I) Batch mixers, that is machines whose mixing process is intermittent, the materials being placed in the mixer, mixed for a certain length of time and then discharged.

(II) Continuous mixers, which class includes all machines into which the materials are fed, and from which the concrete is discharged, continuously without any break in the process.

But this is a popular rather than a technical classification. A better plan will be to divide the various mixers into distinct types according to peculiarity of construction, and then to note in each case whether the particular machine belongs to the batch or continuous class.

Proceeding then with this classification we may divide concrete mixers into eight different types according to their construction:





(1) The Gravity type - those machines which do the mixing simply by allowing the ingredients to drop through a vertical chute, the interior of which has some device for tossing the particles from side to side during their descent.

(2) The Horizontal Drum type - all mixers which consist of a cylinder or double cone which revolves about a horizontal axis.

(3) The Oblong Box type - those machines the mixing receptacle of which is an oblong box with the longer dimension horizontal and which revolves about a horizontal axis through its center.

(4) The Cubical type - those mixers made up of a cubical box which revolves about a horizontal axis through diagonal corners.

(5) The Vertical Drum type - machines that consist of a drum which revolves about a vertical axis.

(6) The Inclined Drum type - those





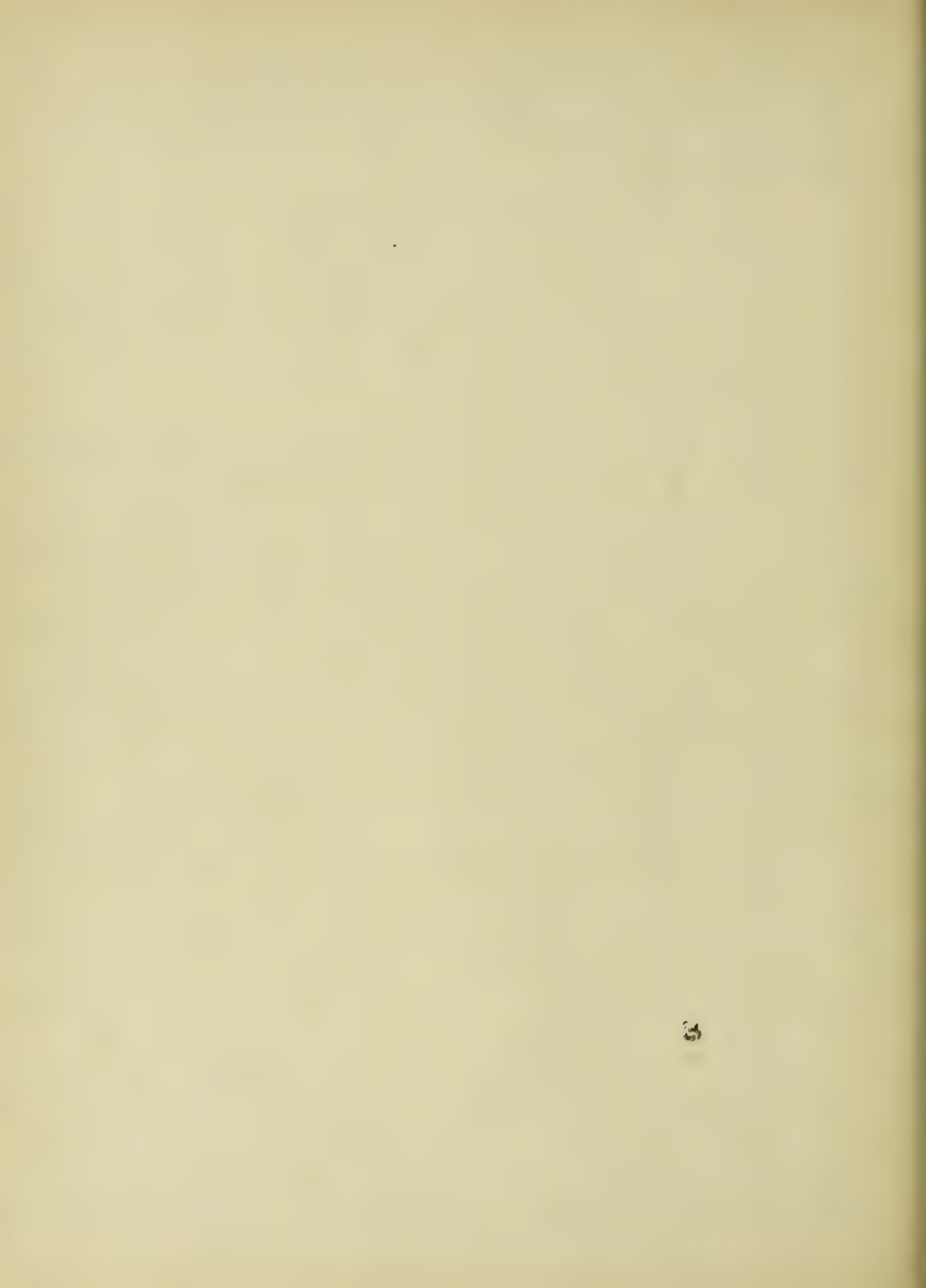
mixers which are made up of a drum which revolves about an inclined axis.

(7) The Oscillating type - mixers which combine the revolution of a drum about a horizontal axis with an oscillating movement at right angles to the direction of rotation.

(8) The "Pug-mill" type - all machines that accomplish the mixing by means of a stationary trough within which is a system of revolving blades.

In the description and explanation of the various types of mixers that have been enumerated, it will evidently be beyond the scope of this article to go into the complete details of each machine. Such completeness will not be necessary by reason of the fact that in most of the above types are several machines which are very much alike in the principle of their construction, and which differ only in minor details. In such cases, therefore, the operation





can be made clear by reference to a similar mixer already described at length, and by special explanation of the peculiar details in question. In each case, however, the capacity, power required for operation, and the prices will be given wherever it has been possible to obtain such data.

### TYPE I - GRAVITY MIXERS

This is the simplest type of concrete mixer and probably that which has been longest in use. The advantages of these machines are: large capacity, simplicity of construction, and elimination of mechanical power for operation.

#### The Hains Gravity Mixer

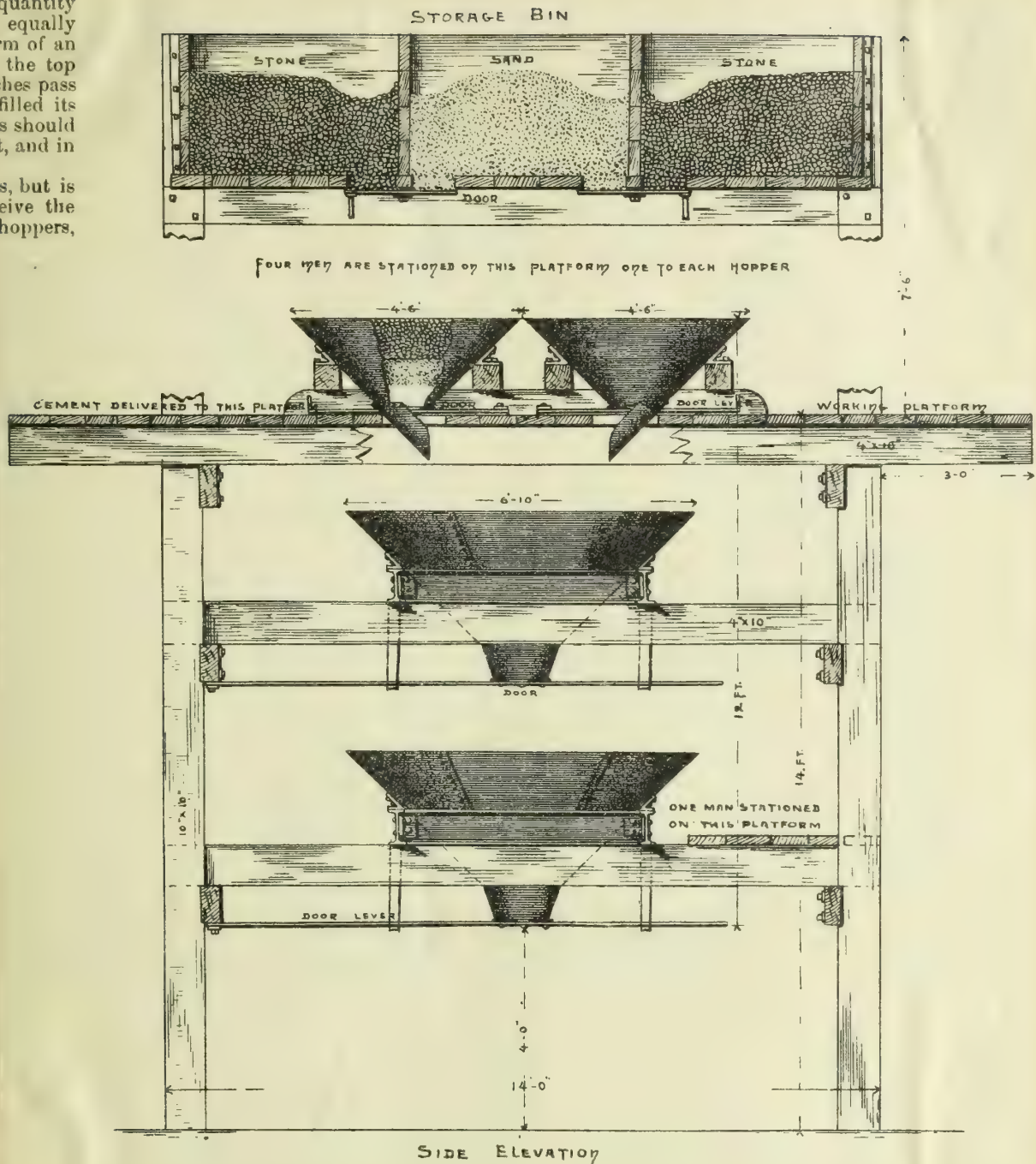
This is a batch mixer and is manufactured by Peter C. Hains of Washington, D.C. As shown in Plate 1, page 8, the arrangement consists of a wooden frame whose total height is twenty one and one half feet. At the top of this frame are three storage





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The Hains Mixer



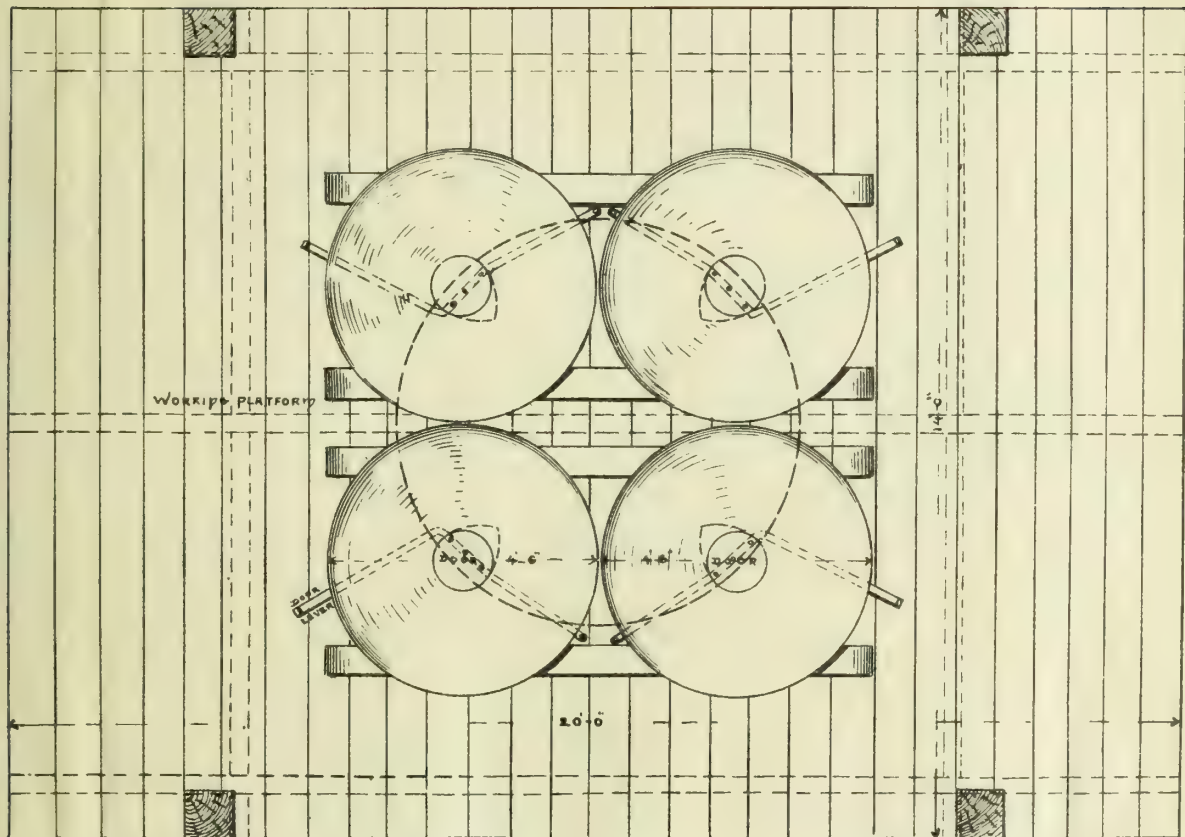


bins. Two of these bins, each with a capacity of  $5\frac{1}{2}$  cu. yds., are for broken stone. The third bin, with a capacity of 6 cu. yds., is for sand. Each of the bins has two doors in the bottom. Four and one half feet below these bins is a platform carrying four steel hoppers, each of which is beneath one of the trap-doors in the bins above. These hoppers also have doors in the bottom, which can be opened or shut with a lever - for a top view of hoppers, see Plate 2, page 10. Four feet farther down is one large hopper and five feet below this is a similar one. Each of these hoppers is also provided with a movable door in the bottom. The bottom of this last hopper is four feet from the ground.

The method of mixing concrete is as follows: The storage bins being filled with materials, and the cement and water being delivered to the top platform, the four men







TOP VIEW OF MIXER (STORAGE BIN LEFT OFF)





stationed there place cement in each of the four hoppers up to a certain measuring mark. The proper amount of sand is then allowed to run out of the storage bin and on top of the sand is placed the required amount of broken stone. Water is then sprayed upon the top of the mass, the doors are opened, either simultaneously or one at a time, and the aggregate drops through to the large hopper below. The door of this hopper being opened, the mass drops through to the next lower hopper and from this to the bottom hopper. The broken stone, being heavier than the sand and cement, and being placed on top of the aggregate, tends to reach the bottom of the mass during the descent. Therefore by the time the lower hopper is reached the concrete is mixed and ready to be discharged through a door at the bottom. One man is usually stationed on the lower platform





in order to operate the levers of the two lower hoppers. The total effective drop of the concrete is about twelve feet.

This machine undoubtedly has an advantage in that no power is required to operate it, and there is no complicated mechanism to get out of repair. A disadvantage arises from the fact that the machine is of such large dimensions that it has to be taken apart and put together again, if moved any considerable distance. The capacity of this mixer is rated at 50 cu. yds. per hour, although it has been known to turn out 60 cu. yds. in that time. The list price is \$1400.

### The Portable Gravity Mixer

This machine is probably the most widely used one of the gravity type now on the market. Although generally used as a batch mixer, it may also be operated as a continuous

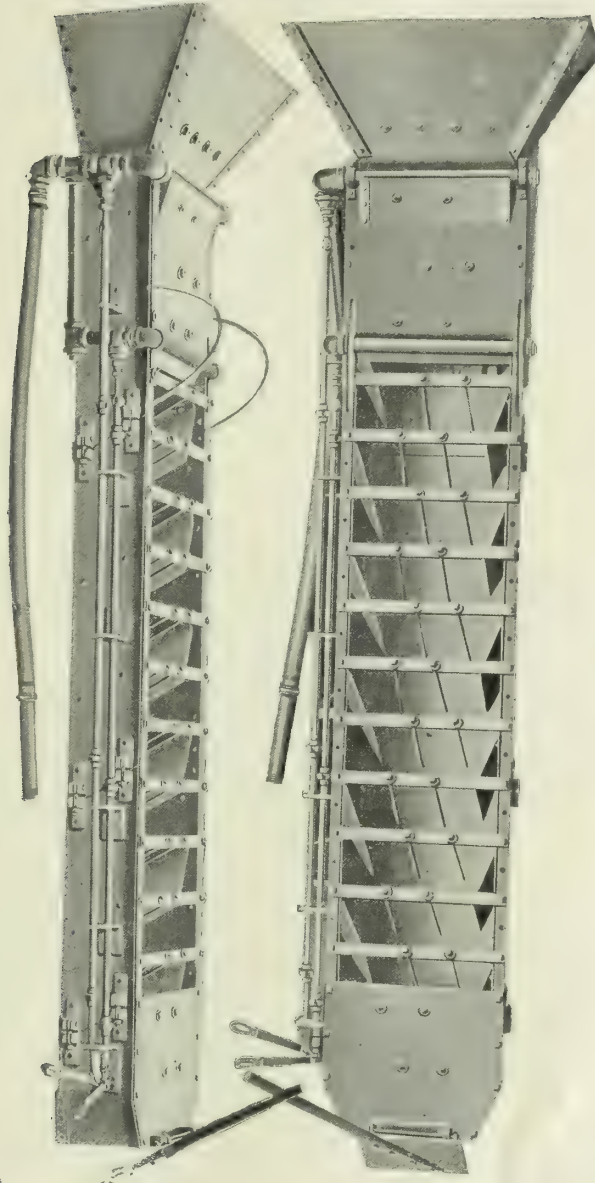


machine. It is manufactured by the United Concrete Machinery Company of New, York. As shown in Plate 3, page 14, the mixer consists of a steel chute ten feet high, attached to the inside of which are a number of blades, known as "deflectors", and a series of cross-pins known as "interfering" pins. When mixing concrete the chute is suspended from a platform to which the materials are delivered — see Plate 4, page 15. A batch is spread out upon the platform in layers as shown in Plate 5, page 16. The broken stone is placed on the bottom, above that the sand, and on top the cement. The aggregate is then tossed into the chute with shovels and is wet by spray-pipes placed close to the top. As the materials fall through the mixer, the different particles are tossed from side to side by the deflectors, and any tendency to stick together in masses is prevented by the interfering pins — see Plate 5, page 16. By the time the





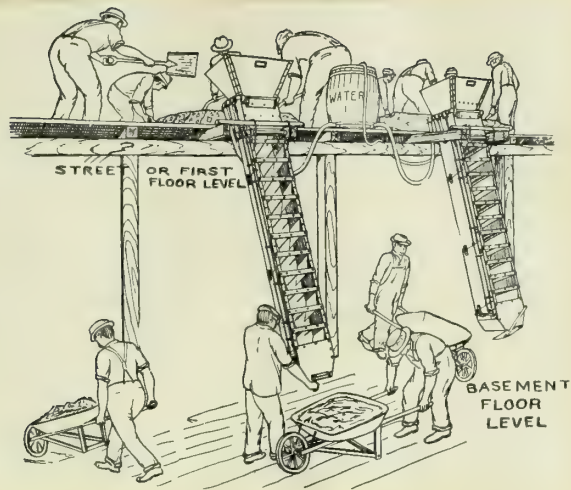
The Portable Gravity



*The Portable Gravity Mixer*

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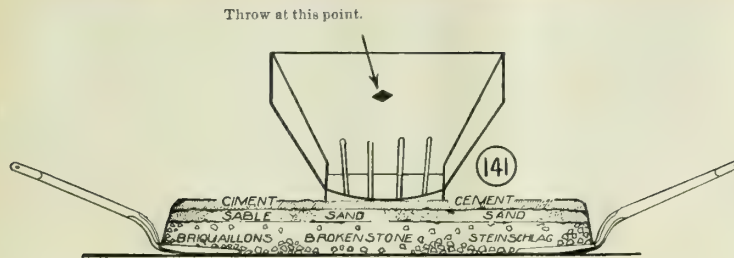




*Portable Gravity Mixer at work  
on the New York Subway*

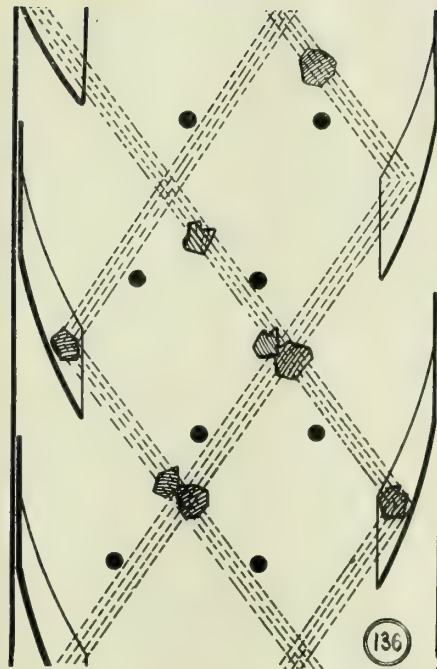
*The Portable Gravity Mixer*

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16

*Arrangement of Batch.*



*Course taken by particles of  
the aggregate during descent.*

*The Portable Gravity Mixer*





aggregate has passed through the chute it has become thoroughly mixed, and is discharged through the open bottom.

In operating this mixer it is important that the chute should not be perfectly vertical but should have sufficient slant so that the friction shall retard the materials to such an extent that about four seconds shall be required to pass through. This position of the mixer has been found by experiment to give the best results.

A "sectional" mixer of the same general dimensions as this machine is also manufactured by this company. The only new feature is that the chute is divided into three sections, any or all of which may be used as desired.

The Portable gravity mixer has the advantages common to its type, namely: no power is required for operation; there is no complicated mechanism to get out of repair.





The capacity of the mixer is 100 cu. yds. per hour if operated as a continuous machine. The list prices are \$425 for the sectional, and \$275 for the non-sectional mixer.

## TYPE 2-HORIZONTAL DRUM MIXERS

These machines are very widely used at the present time. Their distinctive feature is a drum revolving about a horizontal axis. This drum usually contains a system of blades attached to its inner circumference, and as a rule has an opening at each end for receiving and discharging materials. These mixers are for the most part batch machines.

### The Smith Mixer

This mixer shown in Plate 6, page 20, is one of the best known of the batch machines. The manufacturers are the Contractors Supply Company of Chicago. The construction consists of a steel drum of double conical form

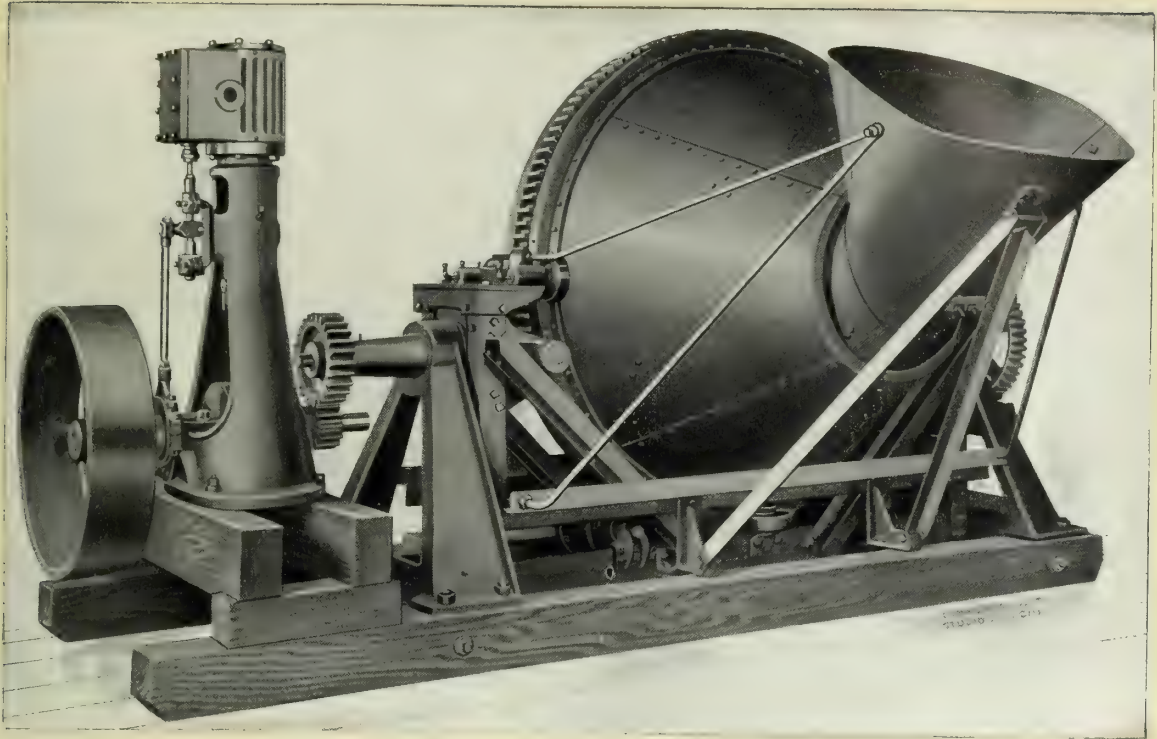


There are circular openings at each end for receiving and discharging materials. The receiving end has a hopper attached. The drum is made to revolve by means of a spur gear, that is, a cog-tooth on its outer circumference connects with a cog-wheel which is attached to the main driving shaft. The interior of the drum contains a system of blades attached spirally around the circumference, as shown in Plate 7, page 22.

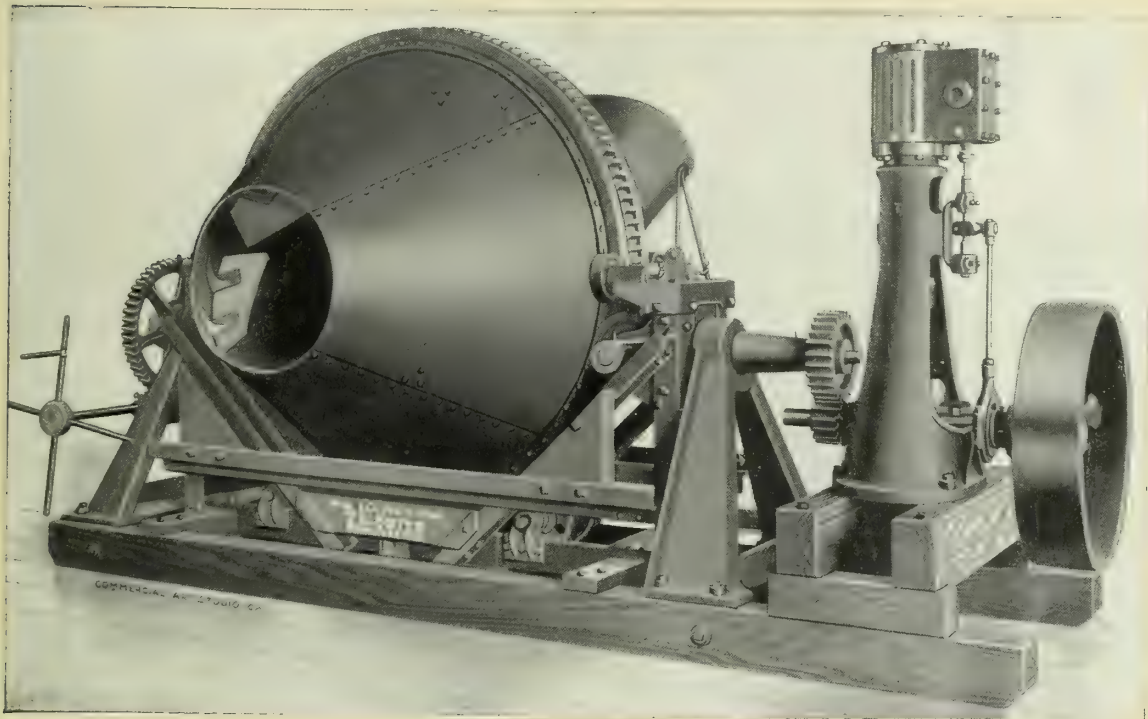
The materials having been measured out in proper proportions, are thrown into the drum in any order. On account of the double conical shape the aggregate keeps sliding toward the center. At the same time the blades are continually working the mass outward again and also carrying it to the top of the drum, from whence it falls back. As a result of this combination of movements the concrete is thoroughly mixed. When the mixing is complete, the discharging end







*Receiving End.*



*Discharging End.*

*The Smith Mixer*



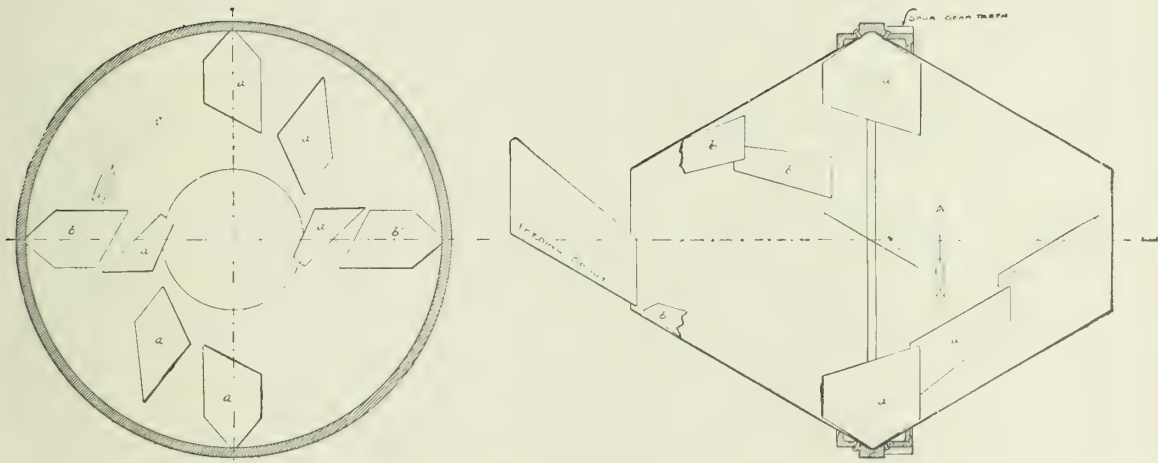
of the drum is tilted down, the batch is then discharged, the drum is brought back to its horizontal position again, and a new batch is thrown in - all while the machine is running at full speed.

Some advantages of the Smith mixer over other machines of the horizontal drum type are: (1) the peculiar shape of the drum, which, as previously stated, causes the aggregate to continually return to the center after being carried outward by the blades, thus insuring a very thorough mixture; (2) the tilting device, which enables the discharge to be made quickly.

The writer has observed several of these machines in operation on foundation work in the city of Chicago. At the new Cook County building a No. 5 mixer was in use, the efficiency of which had been increased 50% by substituting electric for steam power. At the







Sectional Views of Smith Drum, Showing Arrangement of Blades



new Boston Store this mixer was being used on concrete caisson work, as required by specifications. In each of these cases the quality of the concrete that was being made was very good.

Table 1 gives the chief facts about the different sizes of this mixer. Any of these sizes may be mounted either on skids or trucks.

Table 1  
Smith Concrete Mixers

Size	Horsepower Required	Capacity Cu. Yd. per Hr.	List Price Without Power
0	3	6.5	\$ 300.0
1	6	10.0	410.0
2	8	15.0	525.0
3	10	18.0	575.0
4	15	23.0	720.0
5	20	30.0	875.0

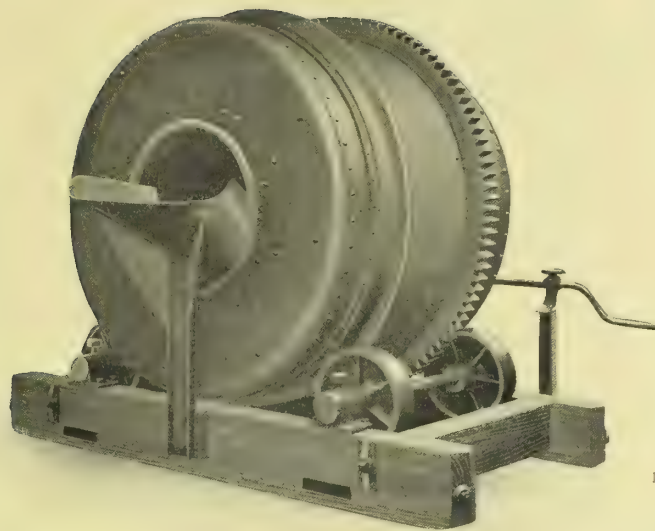




## The Ransome Mixer

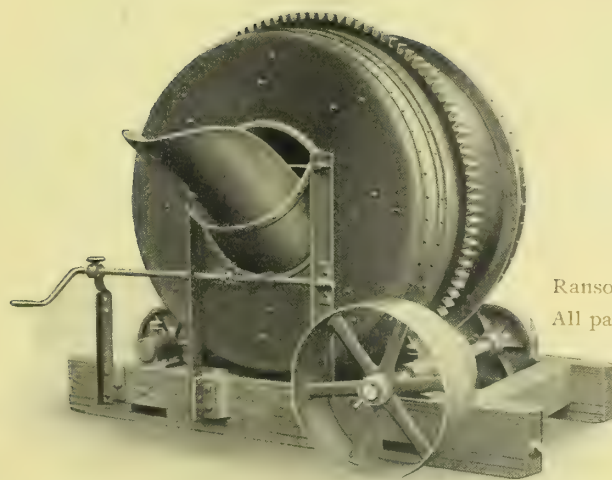
The Ransome Concrete Machinery Company of Chicago manufacture a batch mixer of the horizontal drum type. The construction is as follows: The mixing receptacle consists of a cylindrical steel drum with circular openings at each end - see Plate 8, page 25. This drum is made to revolve about a horizontal axis by means of a spur gear. The interior of the drum has a system of blades or "wings" which are illustrated in Plate 9, page 27. These wings are arranged about the circumference in such a way that the materials after being placed in the receiving hopper, are moved forward toward the discharge end. At the same time they are carried to the top of the drum and dropped back. This forward movement together with the continual dropping causes the particles of the aggregate to become





1905 Model  
Concrete  
Feed

*Receiving End*



Ransome 1905 Mod  
All parts are readil

*Discharging End*

*The Ransome Mixer*

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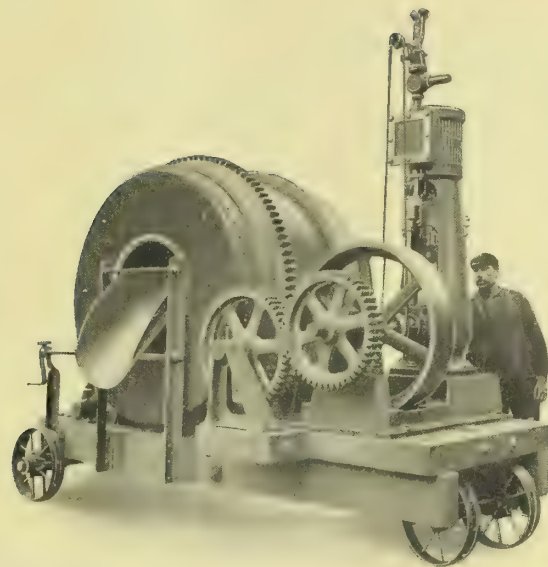


thoroughly incorporated.

Both the receiving and discharging ends of the drum are provided with hoppers for facilitating the handling of concrete. The receiving hopper is attached firmly to the frame upon which the mixer rests and extends slightly into the drum without touching it. The discharging hopper extends well into the drum and by means of a lever can be tilted up or down. When discharging, the outer end of the hopper is lowered and the concrete drops from the roof of the drum into the hopper and passes out of the machine.

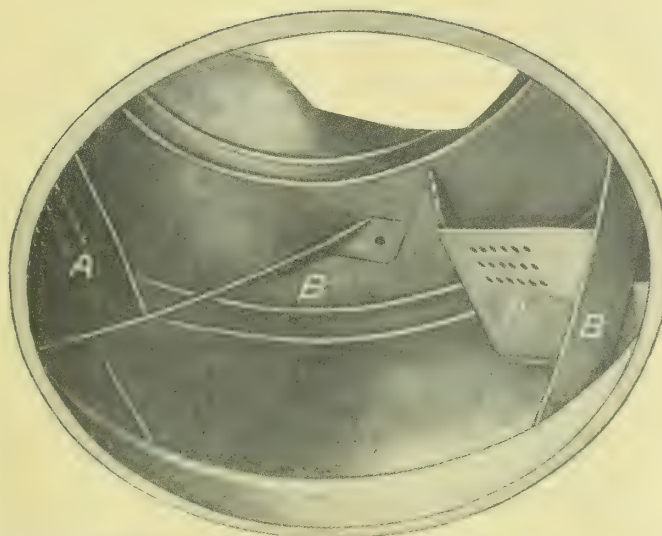
As an advantage of this mixer might be mentioned the fact that it is simple in construction and therefore easy to keep in repair. The method of discharging has an advantage in that it does away with a complicated mechanism for tipping the drum but a disadvantage in that it is not very rapid.





1905 Mod  
Not

*Position of Hopper when discharging*



1905 Mod  
View  
arranged

*Arrangement of "Wings"*

*The Ransome Mixer*





In the Engineering News of June 18, 1903, Mr. H. P. Gillette, Consulting Engineer of New York City, states that he has used these mixers on various kinds of work, and that the average time required for completing a batch varies from two to four minutes, according to the facilities at hand for supplying materials to the machine.

Table 2 gives the different sizes of the Ransome mixer, with corresponding prices, capacities and power required for operation.

Table 2  
Ransome Concrete Mixers

Size	Horse-Power Required	Capacity Cu. Yd. per Hr.	List Price Without Power
1	5	10	\$ 425.0
2	10	20	475.0
3	14	30	550.0
4	20	40	630.0

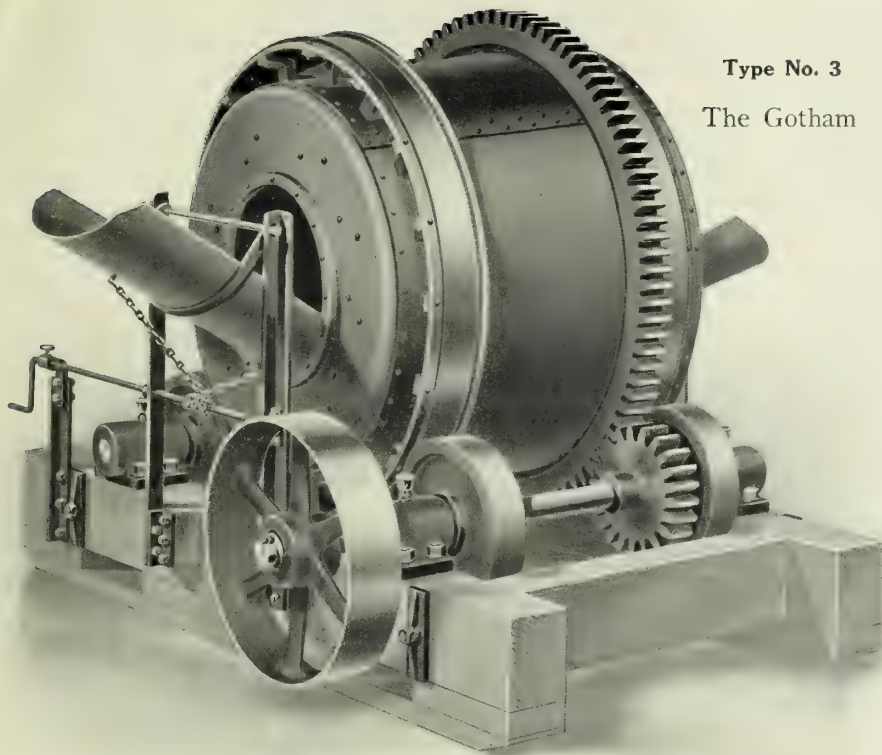


## The Gotham Mixer

The United Concrete Machinery Company of New York City manufacture this batch mixer. In its construction and operation it is almost identical with the Ransome machine previously described on page 24. The mixing drum is of the same general shape and has a similar system of blades attached to its inner circumference. The receiving and discharging chutes are also practically the same. The driving gear is of direct connection like that of the Ransome, but is somewhat simpler. The construction is of steel throughout. Plate 10, page 30, shows a view of this mixer mounted on wooden skids. Four different sizes of the machine are made. Table 3 gives the principal facts about each of these sizes.







Type No. 3  
The Gotham

*The Gotham Mixer*

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Table 3  
Gotham Concrete Mixers

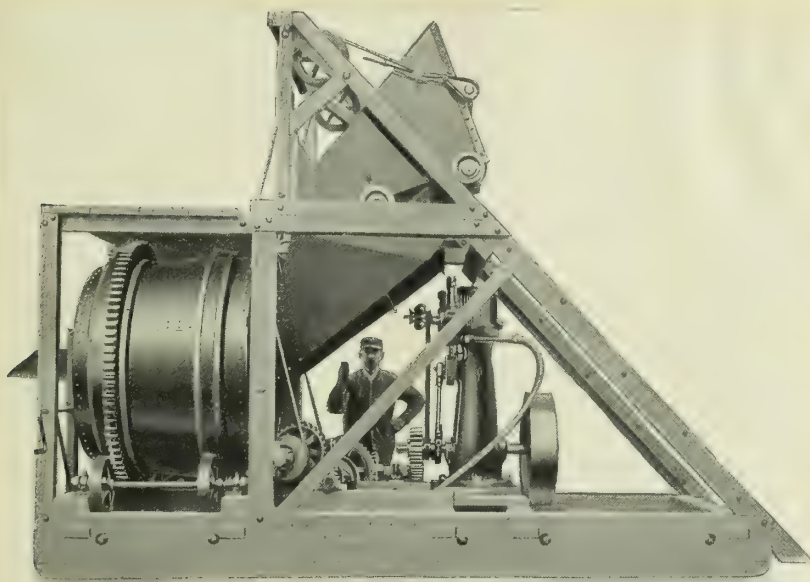
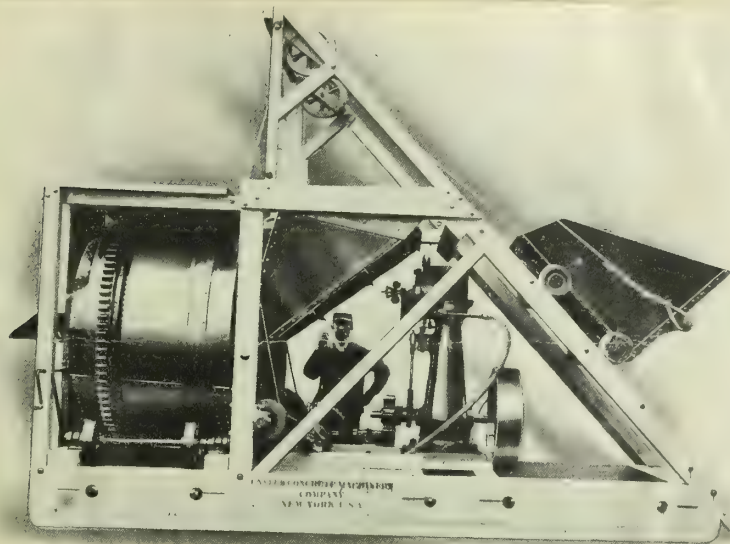
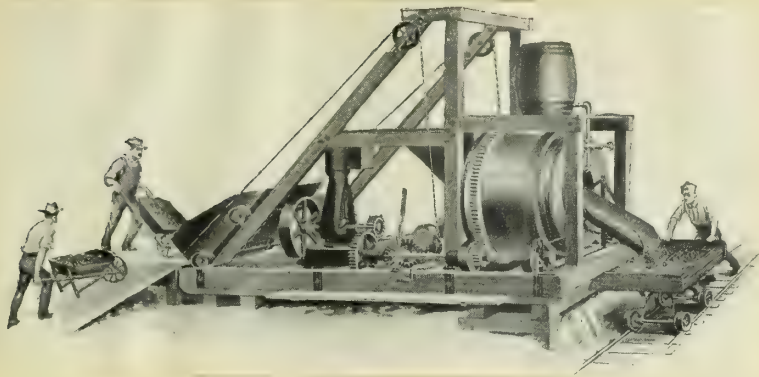
Size	Horse-power Required	Capacity Cu. Yd. per Hr.	List Price Without Power
A	5	10	\$360.0
B	10	20	405.0
C	14	30	470.0
D	20	40	539.0

### The International Mixer

This batch machine is also manufactured by the United Concrete Machinery Company of New York City. It is exactly the same as the Gotham which has just been described on page 29, with the exception that a feeding device is added. As shown in Plate 11, page 32, this device consists of a stout oak frame, which has an inclined runway upon which a dump car operates. A batch, having been placed in this car, the vertical lever shown near the main driving shaft, is pulled, thus bringing a bevel gear into action. Connected







*The International Mixer*



to this gear are two spindles about which are wound ropes, which passing over pulleys at the top of the frame are carried on down and attached to the back of the dump car. When the starting lever is pulled the spindles revolve, the rope is wound up, and the car runs up the inclined track to a certain point where it is stopped by a clutch. The spindles continuing to revolve, the back of the car now rises from the track and the batch of materials slides out and into the receiving hopper. At the front end of this frame and directly over the mixer, is a platform upon which is placed a barrel of water from which a spray-pipe leads to the mixing drum. A convenient method of hauling away the concrete is also shown in connection with this machine. A narrow track is laid close to the machine and small dump cars run directly under the discharging chute to facilitate loading.

The power required and the





capacity of the International mixer, are the same as for the Gotham - see page 31. The writer was unable to secure any prices on this machine but they would evidently be somewhat more than those of the Gotham on account of the addition of the feeding device

The United Concrete Machinery Company also manufactures a number of other mixers of the horizontal drum type, but they are so nearly like the Gotham in construction and operation that they need no further comment here, with the exception of the Steam Heated Batch machine, shown in Plate 12, page 35, and the United mixer illustrated in Plate 13, page 37.

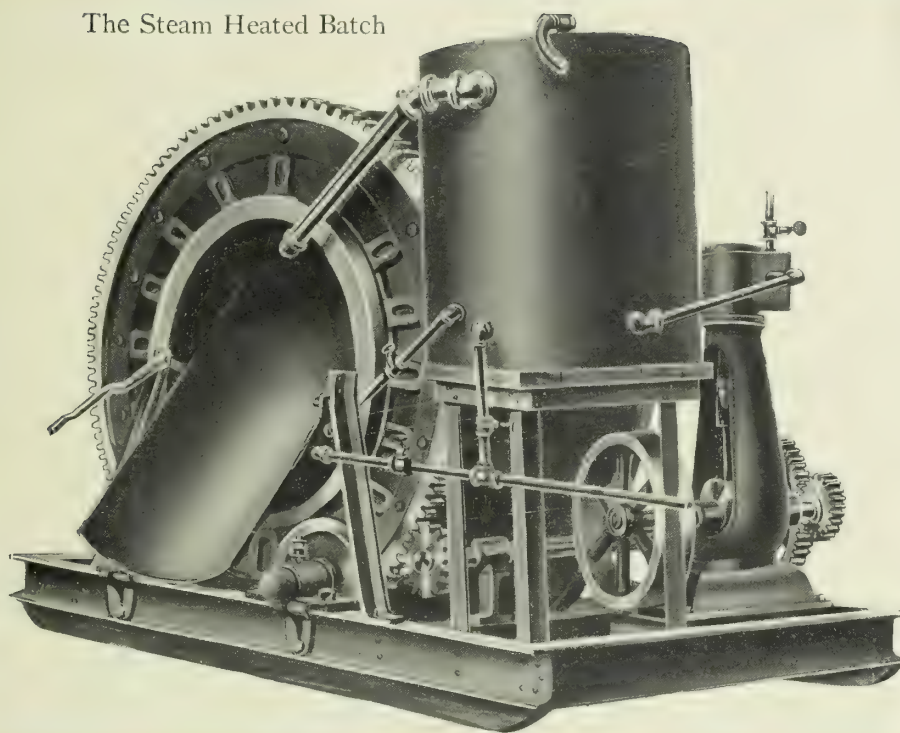
#### The Steam Heated Batch Mixer

This machine has as a unique feature, a system of pipes in the interior of the drum through which exhaust steam is introduced from the



**Type No. 14**

The Steam Heated Batch



*The Steam Heated Batch Mixer*

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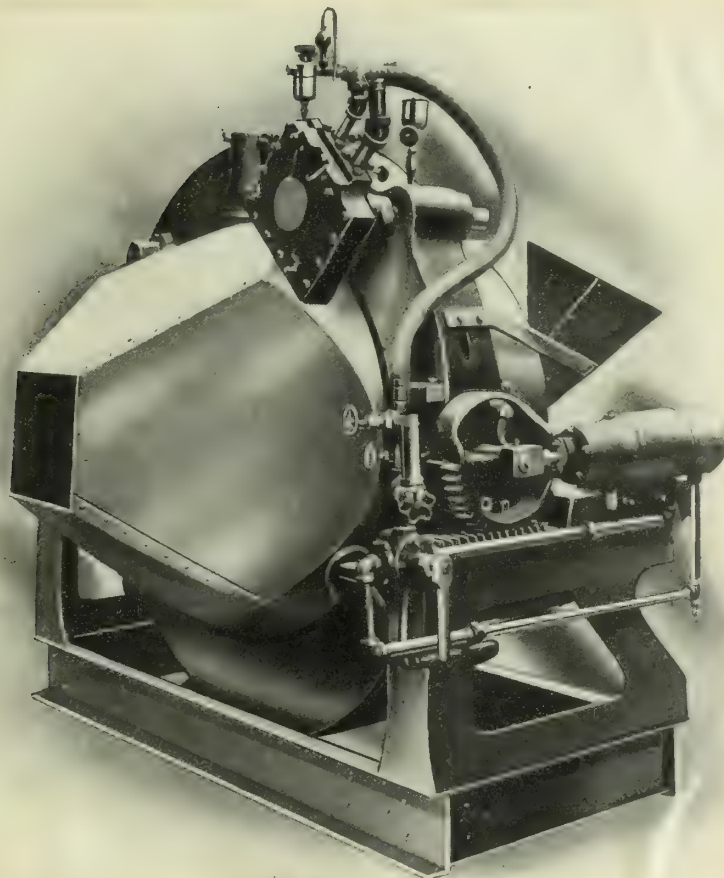
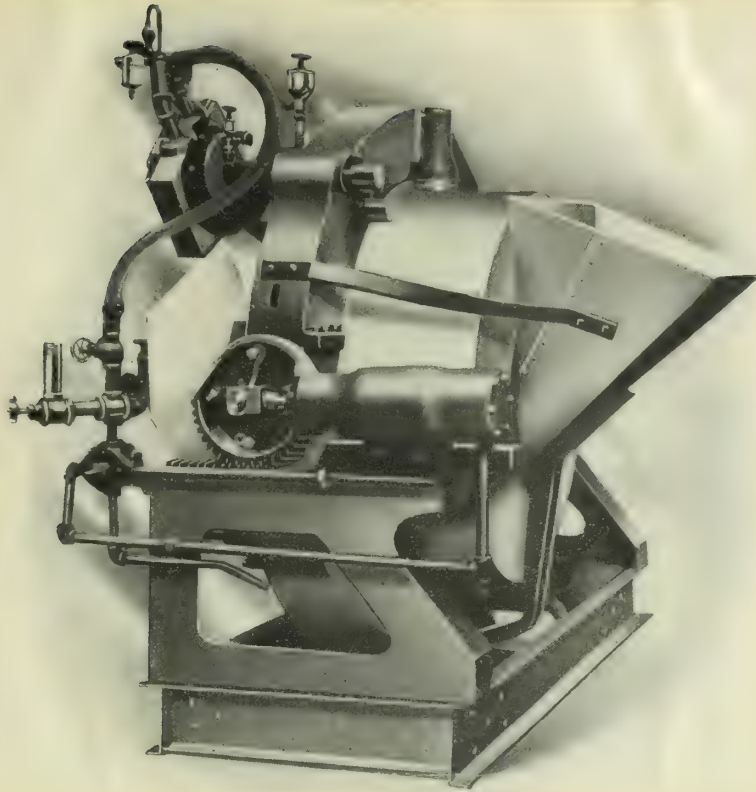


operating engine. Before entering the drum, the steam passes through a jacket enclosing the water tank, and thus heats the water before it enters the aggregate. The pipes in the interior of the drum heat the aggregate during the mixing process. The advantage of this heating device is that concrete can be mixed in cold weather without freezing.

### The United Mixer

This is a batch machine of the horizontal drum type but has an outer casing around the drum in order to protect the working parts from dust. It has practically the same inner arrangement as the Gotham but differs in its method of discharging. This method consists of lowering the discharge end of the drum, which has the shape of a truncated pyramid, thus allowing the concrete to run out. This lowering is accomplished by means of a spur gear operated





*The United Mixer*





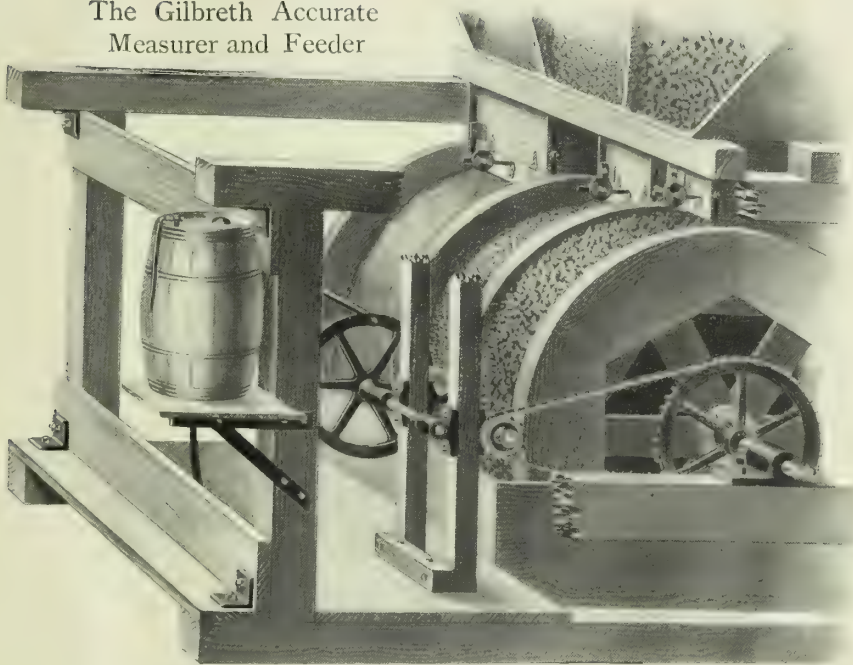
by a small steam piston.

The United mixer is made in three sizes holding respectively 10, 20, and 30 cu. ft. per batch and having an hourly capacity of 10, 20, and 30 cu. yds. respectively.

It might be well to make mention here of an automatic measuring and feeding device manufactured by this same company, and which is called the Gilbreth Accurate Measurer and Feeder. As shown in Plate 14, page 39, this device, which is placed above the concrete mixer, consists of three wooden hoppers placed above a revolving drum also of wood. This drum has three circular troughs on its circumference, each trough passing directly under one of the hoppers. Each hopper has a gate in the bottom, which can be opened so as to allow the material to flow out upon the revolving drum, from whence it is carried to the receiving hopper of the mixer below. By regulating these gates, the



Type No. 16  
The Gilbreth Accurate  
Measurer and Feeder



*The Gilbreth Measurer and Feeder*



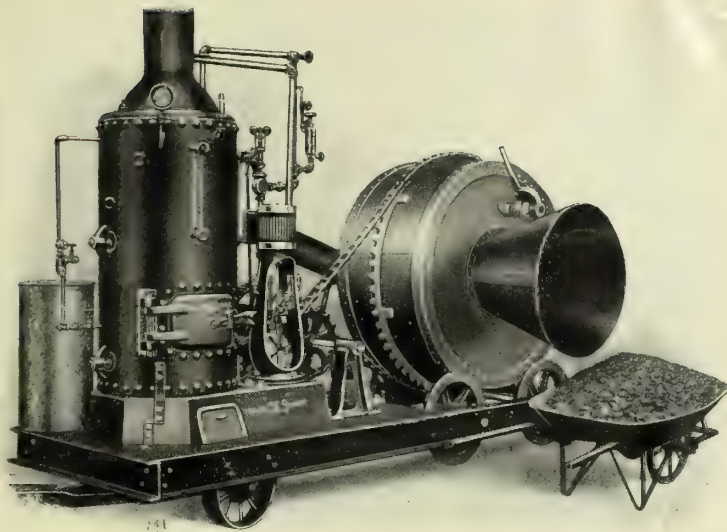


sand, stone, and cement can be fed automatically in any desired proportions. The writer has never seen this device in operation and he doubts its efficiency on account of the probability of the bins getting choked with material.

### The McKelvey Batch Mixer

The principle of this batch machine is very similar to that of the Ransome, previously described on page 24. The manufacturers are the McKelvey Concrete Machinery Company of Chicago. A revolving steel drum is the receptacle for the concrete. This drum contains two longitudinal blades attached to its inner circumference. These blades, which are known as "gravity shovels", carry the aggregate to the top of the drum from whence it continually drops back to the bottom - for an illustration of this action see Plate 15, page 41. Power is transmitted to the mixer





OPERATION OF THE GRAVITY SHOVEL.

*The McKelvey Batch Mixer*





by a chain and sprocket. The materials are fed through one end of the machine and the completed batch is discharged through the other end. The discharging chute is a steel funnel extending into the drum. At the inner end of this funnel is a hinged apron which can be operated by a lever attached to the drum itself. When discharging, this apron is raised, thus catching the concrete and allowing it to run out of the machine. This mixer is made in several sizes the two most commonly used being given in Table 4.

Table 4  
McKelvey Batch Concrete Mixers

Size	Horse-power Required	Size of Batch Cu. Ft.	Capacity Cu. Yd. per Hr.	List Price Without Power
7	5	9.0	7.5	\$400.0
8	2	4.5	4.0	275.0



## The McKelvey Continuous Mixer

This machine is also manufactured by the McKelvey Concrete Machinery Company of Chicago. The construction is clearly shown in Plate 16, page 44. A steel drum open at both ends is the receptacle for the concrete. This drum is made to revolve on ball bearings by means of a chain and sprocket arrangement. Any kind of power may be used for the operation, that shown in Plate 16 being steam.

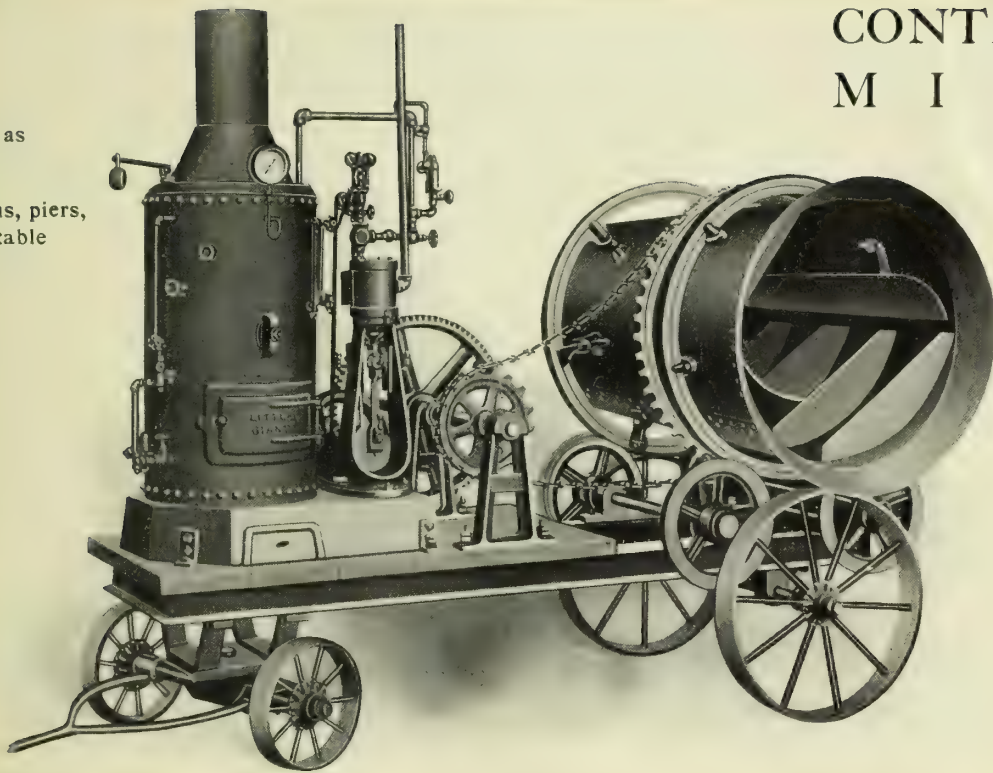
The near end of the drum in the illustration, is the discharging end. The materials, having been previously proportioned are thrown in at the other end of the machine, and water is added either by buckets or a hose. The vertical blades in the interior of the drum keep "cutting" the aggregate while the horizontal shovels are continually carrying it to the top. This combination of movements





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CONTIN  
M I X

*The McKelvey Continuous Mixer*



tends to mix the mass, and the continual throwing in of new materials keeps forcing the concrete out of the discharge end. This mixer requires 2 Horsepower for operation. The capacity is 10 cu. yds. per hour, and the list price is \$600 including the engine.

The writer saw a McKelvey continuous mixer at work on the construction of the new Boston Store, Chicago. The concrete that was issuing from the machine was poor in quality, being too wet in some places and too dry in others. The Engineer in Charge of the work stated that he allowed this machine to be used only on work of minor importance, such as basement floors, etc.

### The Buffalo Mixer

This is another mixer of the horizontal drum type. It is a continuous machine and is made by the Buffalo Concrete Mixer Company of Buffalo, N. Y. The operation is as

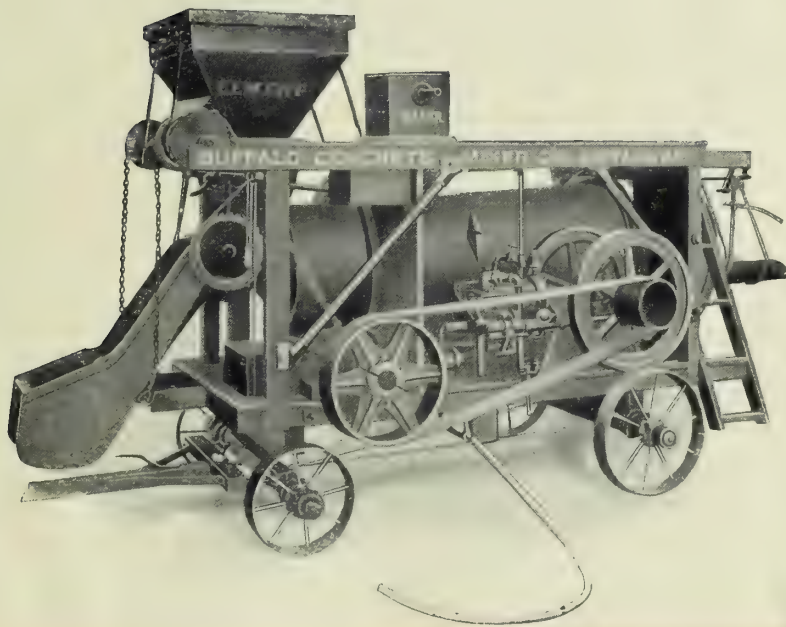




follows: The materials are mixed in a revolving drum of cylindrical form, the axis being horizontal - see Plate 17, page 47. Within the drum is a system of blades attached to the inner circumference. Water is fed from a tank above the drum, cement from a hopper also placed above the drum, and sand and crushed rock from a hopper at the front of the machine. This hopper swings on a pivot so that it can be dropped down close to the ground when receiving materials. When full of sand and rock it is raised by a device operated by steam, and the materials pass into the revolving drum. At the same time an automatic feeding device in the bottom of the cement hopper allows the proper amount of cement to enter the drum.

The sand, rock, and cement are now mixed dry for one half the length of the drum. Water is then sprayed upon the aggregate,





*The Buffalo Mixer*





and the mixture passes on to the end. For discharging the concrete there is an adjustable scoop which can be shoved into the drum, thus catch the concrete and allowing it to pass out. At any time the scoop may be withdrawn, so that the discharge may be either continuous or intermittent. Power for the operation of the mixer is furnished by a small gasoline engine attached at one side of the revolving drum. The construction of the machine is of steel throughout.

Two advantages of this mixer that might be named are: (1) the unusual length of the revolving drum, which allows the aggregate to be first mixed dry; (2) the low position of the sand and rock hopper, thus making the feeding of those materials very easy.

Four Horse-power is necessary for the operation of this mixer. The capacity is  $7\frac{1}{2}$  cu. yds. per hour.



and the list price is \$800.

### TYPE 3 - OBLONG BOX MIXERS

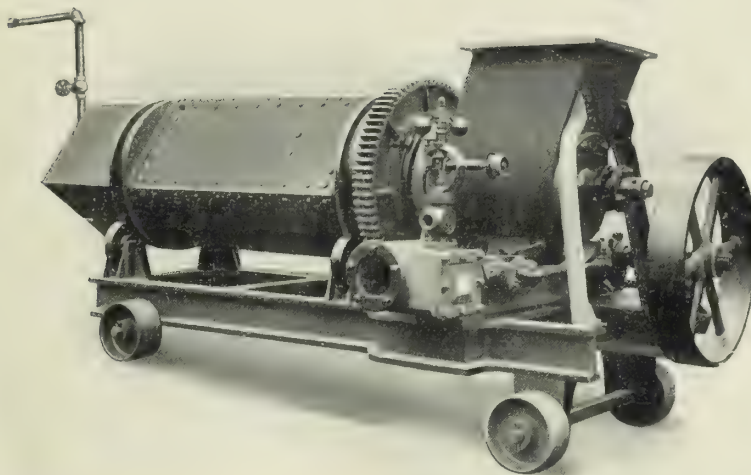
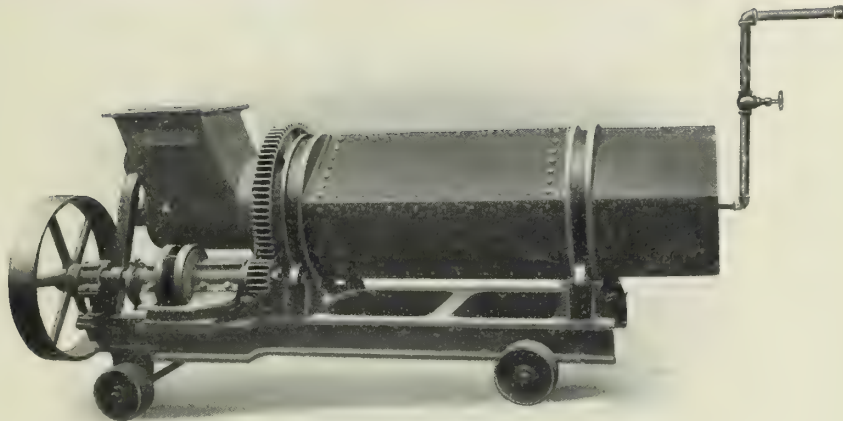
The distinctive feature of these machines is an oblong box containing no inside blades of any kind, and revolving about a horizontal axis. The sole means relied upon to do the mixing is the impact of the particles of the aggregate against the sides of the box during revolution.

#### The Cockburn Barrow & Machine Co's. Continuous Mixer

This machine is manufactured by the Cockburn Barrow & Machine Company of Jersey City, N. J. The concrete is mixed in an oblong box of steel which revolves about a horizontal axis. This mixing box has no inside blades or other interior parts, the tossing of the materials from side to side during revolution being depended upon to do the mixing. The materials after having been







*The Cockburn Barrow & Machine Co's Continuous Mixer*



proportioned are fed into a single hopper as shown in Plate 18, page 50. A screw feed carries them into the mixing box. For an explanation of a screw feed see page 79. Water is admitted from a pipe which enters the box at its axis. The concrete is discharged at the end of the box.

This machine has the advantage of simplicity in construction, but the disadvantage of an awkward method of feeding and discharging. The capacity of the mixer is 25 cu. yds. per hour and the list price including the operating engine is \$900.

#### TYPE 4-CUBICAL MIXERS

The construction of these machines is very simple, consisting of a cubical box without any inner parts whatever, and which revolves about a horizontal axis through diagonal corners. The feeding and discharging may be accomplished either through an





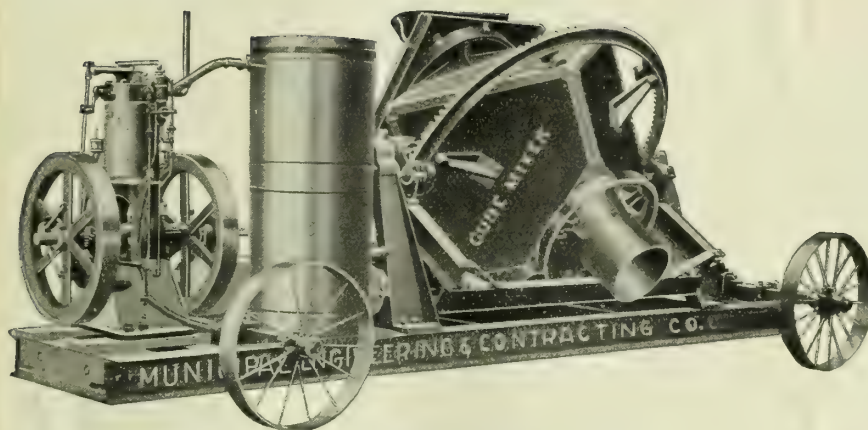
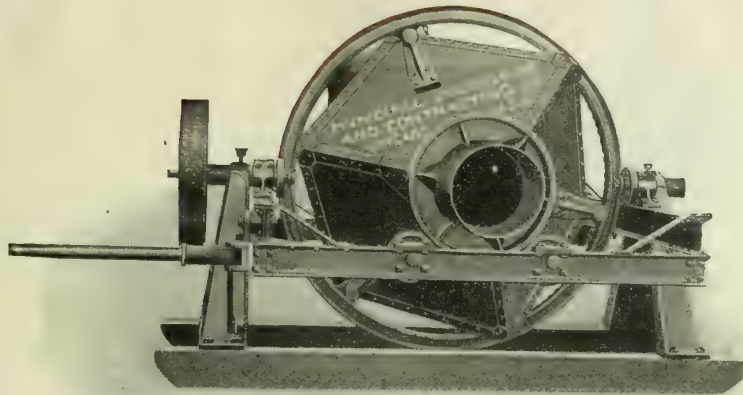
opening in the axis of the box or through a door in one side. These mixers are always batch machines.

### The Chicago Cubical Mixer

An illustration of this mixer will be found in Plate 19, page 53. It is a batch machine and is manufactured by the Municipal Engineering and Contracting Company, Chicago.

The receptacle for the concrete is a cubical box of steel which revolves about a horizontal axis through diagonal corners. A receiving hopper is placed at one of these corners and a discharging chute at the other. The interior of the box is devoid of any blades. When discharging a batch the cube can be tilted - by means of hand power in the smaller sizes and steam power in the larger. The revolution goes on however both during feeding and discharging, thus avoiding much loss of time between batches. The mixing





DISCHARGING

*The Chicago Cube Mixer*



box is of high carbon steel and the supporting frame of structural steel.

Mixing is accomplished solely by the tossing about of the aggregate, the particles of which are thrown from side to side of the box six times during each revolution. As the best speed for operation has been found to be fifteen revolutions per minute, the aggregate is therefore given a complete shake-up ninety times during that period.

Chicago Cube mixers are built in seven sizes any of which may be mounted on skids or trucks. Any kind of power may be used for operation. Table 5 gives the different sizes together with the power required, capacities, and list prices.





Table 5  
Chicago Cube Concrete Mixers

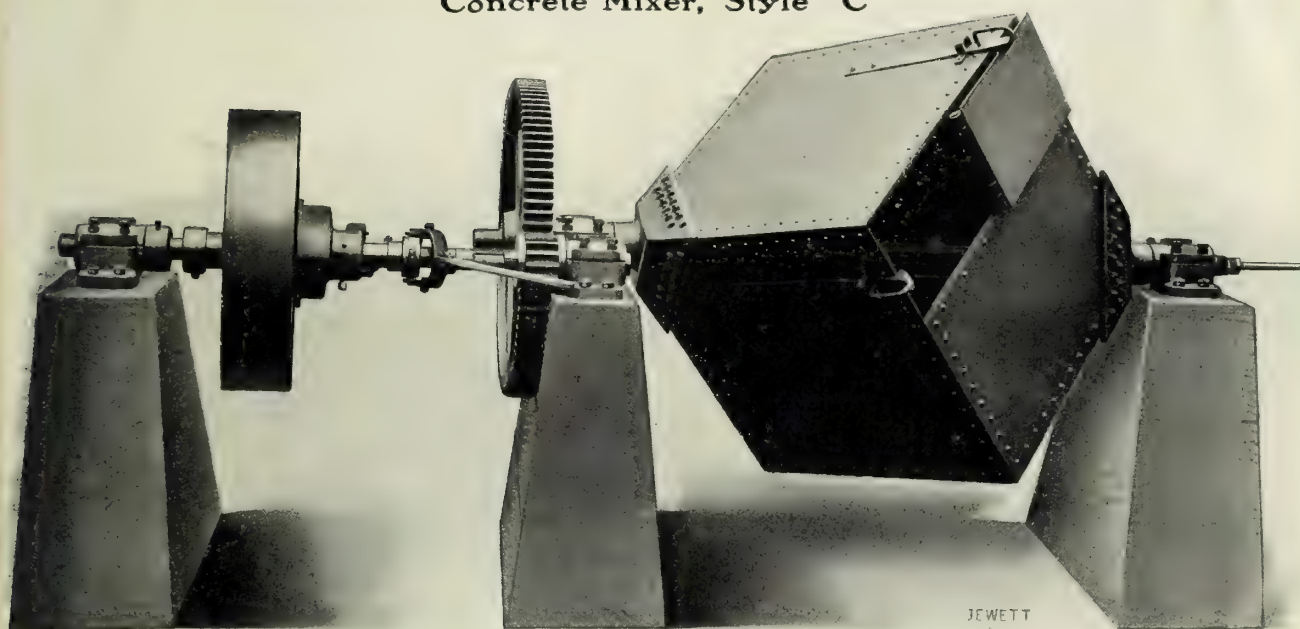
Size	Horse-power Required	Capacity Cu. Yd. per Hr.	List Price - Without Power	
			On Skids	On Trucks
64	20	71	\$2400.0	\$3300.0
33	12	36	875.0	1195.0
22	9	24	720.0	1015.0
17	6	19	525.0	745.0
11	5	12	410.0	605.0
6	3	5	300.0	445.0
"Handy" Mixer	1	3	150.0	180.0

The Cockburn Barrow & Machine Co's Cubical Mixer.

This is a batch machine which is similar in operation to the Chicago Cube mixer described above. a cubical box revolving about a diagonal axis is the receptacle for mixing the concrete. The materials having been previously proportioned are placed in the box through a trap door in the side and are mixed by the tossing about of the particles from side to side. It is claimed that eight turns of the box will mix the concrete thoroughly. Water is fed



Concrete Mixer, Style "C"



*The Cockburn Barrow & Machine Co's. Cubical Mixer*





into the aggregate through a pipe in the axis of the box. The concrete is discharged through the same opening that receives the materials - see Plate 20, page 56.

This mixer has the advantage of simplicity of construction but the disadvantage of the awkward method of feeding and discharging. The capacity of the machine is one yard at a batch and the list price is \$400.

## TYPE 5-VERTICAL DRUM MIXERS

The chief advantage of this type of mixer is that the open end of the revolving cylinder, composing the drum, is turned upward, thus allowing the mixing to be in plain sight of the operator. The principal machine of this kind now in use is the Campbell mixer.

### The Campbell Mixer

The Clyde Iron Works of Duluth, Minn. manufacture this machine, which

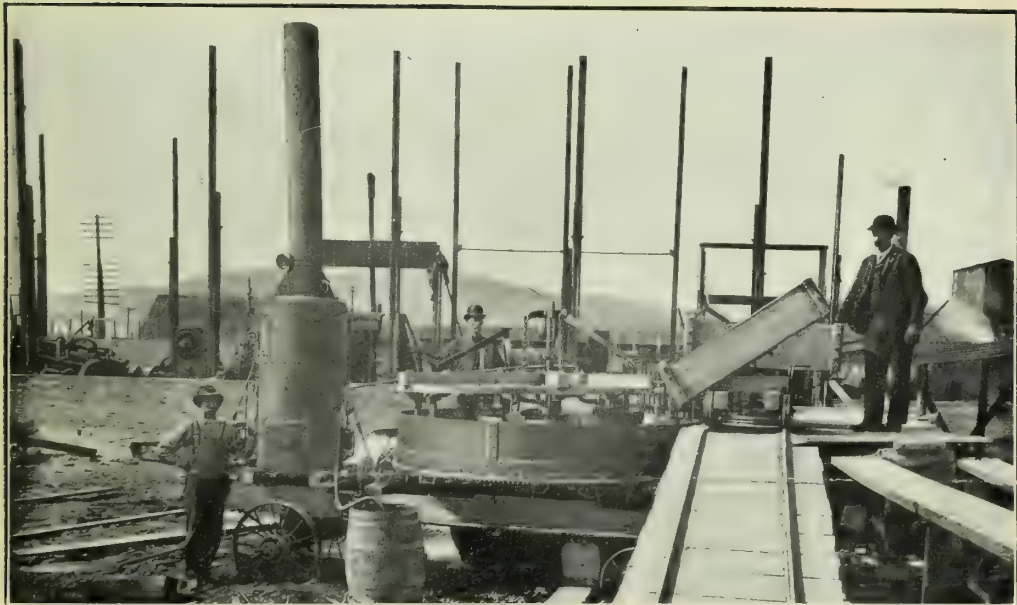
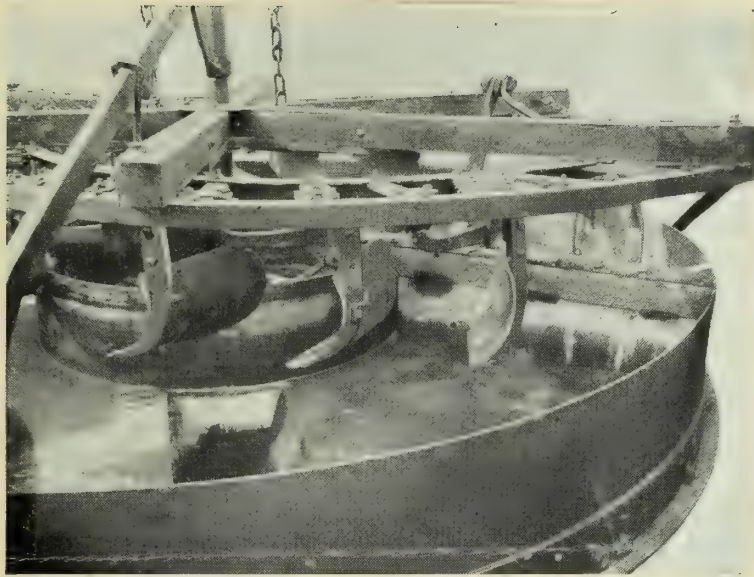


is a batch mixer made up of a drum revolving in a horizontal plane. As shown in Plate 21, page 59, there are two sets of stationary knives or blades within the drum. These knives are arranged in reverse order, one set being placed at such an angle as to throw the concrete toward the outside of the drum and the other so as to force it in toward the center. This arrangement mixes the concrete very thoroughly. Water is supplied to the mixture by means of a spray-pipe.

To discharge a batch of concrete the mixing blades are raised by means of a lever, and a scraper—which is attached to the same frame as the blades—is lowered and at the same time three trap-doors in the bottom of the drum are dropped, the batch is quickly forced out, the doors are closed again, and the machine is ready for a new batch. The feeding may be done in various ways:







*The Campbell Mixer*





By dropping the materials into the drum from bins placed above; by dumping from small cars on an elevated track; or by shoveling direct from the ground. The motion of the drum is continuous both while feeding and discharging.

This mixer has an advantage in that the mixture is always in sight, but a disadvantage in that the high position of the drum makes feeding difficult except from an elevated position. Table 6 gives the principal facts about the different sizes of this machine.

Table 6  
Campbell Concrete Mixers

Size	Horse-power Required	Capacity Cu. Yd. per Batch	Capacity Cu. Yd. per Hr.	List Price - With Power	
				On Skids	on Truck
1	4	1/3	10	\$450.0	\$400.0
2	5	1/2	15	600.0	550.0
3	7	1	25	—	900.0

## TYPE 6 - INCLINED DRUM MIXERS

The advantages of this type of machine are: (1) the mixing is always



in plain sight; (2) On account of the inclination of the bottom of the drum the aggregate is continually rolling back over itself, thereby greatly improving the mixing.

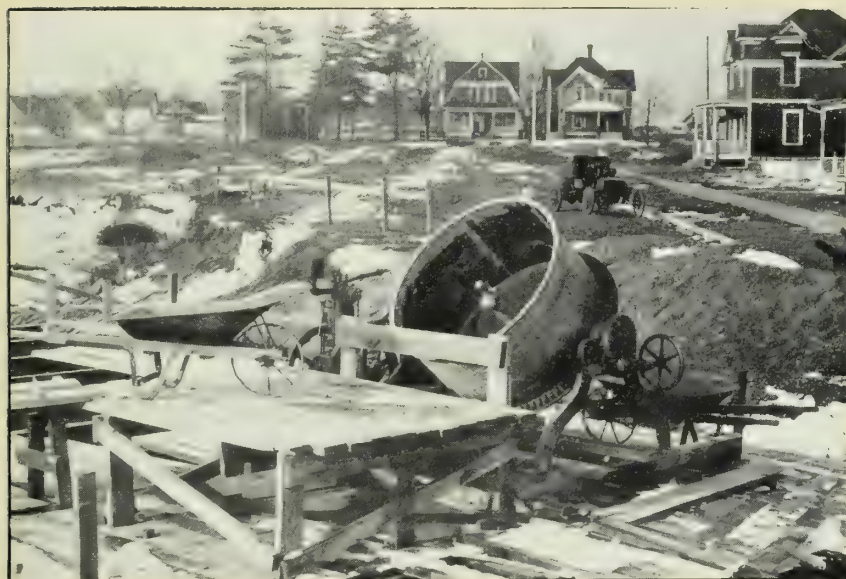
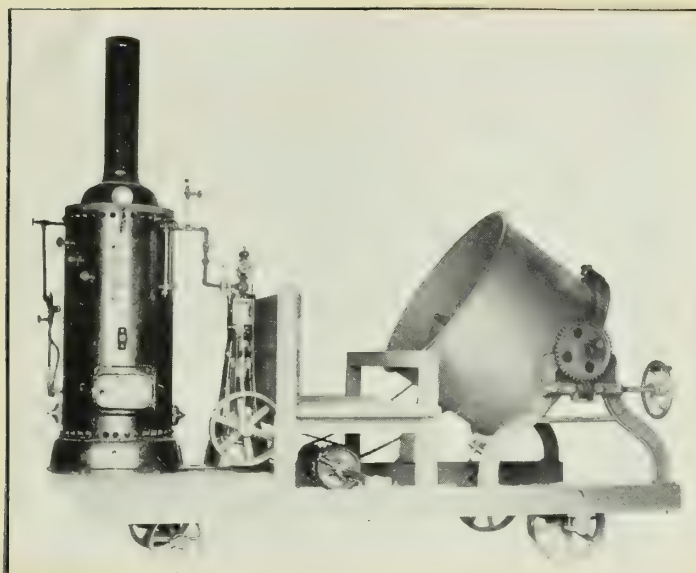
### The Snell Mixer

The R. J. Snell Manufacturing Company of South Bend, Indiana, manufacture a batch machine the distinctive feature of which is a revolving drum inclined at an angle of about sixty degrees with the horizontal.

Plate 22, page 62, gives a view of this mixer. The mixing drum is of steel and holds one third of a yard of concrete. The top of the drum is entirely open; the bottom has an outer run of cog-teeth which is connected to a cog-wheel which in turn is connected to the main driving shaft. Thus the drum is revolved, the power used being either a gasoline or steam engine. In the axis of the drum and at right angles to the bottom is a







*The Snell Mixer*



steel bar. This bar does not revolve with the drum but remains stationary. At right angles to the bar is attached a rod containing a number of holes through which may be placed one or more stirring paddles. As the drum revolves these paddles, remaining stationary, keep the aggregate continually worked up. The mixer is mounted on a strong steel frame which in turn is attached either to skids or to a truck. The batch of materials is usually placed in the mixer from an elevated platform as shown in Plate 22. When ready to discharge, the wheel shown at the left of the frame is turned. A gear is thereby thrown into action, the drum is tipped backward, and the concrete slides out.

Several advantages of this mixer are: (1) simple construction, (2) visible mixing, (3) inclination of the drum. This latter feature causes the particles to keep rolling back as the drum





revolves thus causing them to become thoroughly mixed. Probably a disadvantage is the method of backward tipping when discharging; for considerable time would be consumed by this process.

The capacity of this mixer, as stated is one third of a cubic yard at each batch - from six to eight cubic yards per hour. The price without power is \$200.

### The Page Mixer

This is a batch mixer which is not at present on the market. It was designed by Mr. J. W. Page of the firm of Page and Shuabert, Engineers and Contractors of Chicago, merely for use on the contracts of that company. The writer while recently at Lockport, Illinois, saw one of these machines in operation.

The construction and operation were in general similar to that of the Snell mixer described above. The mixing drum which was eight





feet in diameter by four feet deep, was mounted on a revolving shaft, which was inclined at an angle of  $52^{\circ}$  with the horizontal. The only inside attachment of the drum consisted of a single cross-piece fastened at about one foot from the bottom. A platform was erected close to the mixer for convenience in feeding. Water was supplied from a hose above the drum. When discharging a batch the mixer was stopped, and a door in the side of the drum opened. To operate the machine a 20 Horsepower steam engine was used.

The writer took occasion to time the mixing of one batch and found that one minute and a half were required. The owners of the machine do not, however, claim to complete each batch in this time. They estimate three and one half minutes as the average period for each batch, including all delays. This would make the capacity about 20 cu. yds.



per hour.

During the mixing process the pieces of crushed rock were constantly being carried toward the higher side of the drum, and as they rolled back toward the bottom, they were very thoroughly coated with cement and screenings. The cross-arm was continually plowing through the mass, still further incorporating it. The quality of the mixing done by this machine was easily the best that the writer has yet seen.

#### TYPE 7-OSCILLATING MIXERS

The peculiar feature of this type of mixer is the combining of an oscillating with a rotary movement. The only machine of this kind, to the writer's knowledge, is a small batch mixer manufactured by the Williams-Forest Machine Company of South Bend, Ind., and known as the Clover Leaf Mixer.

The concrete is mixed in a

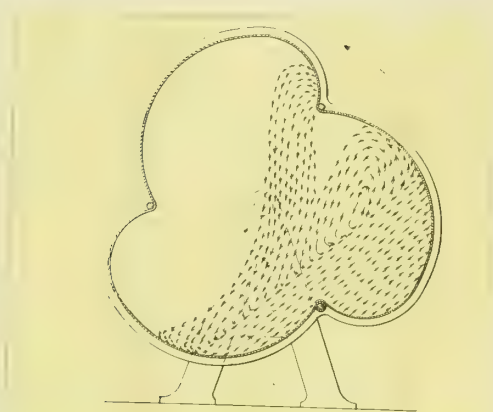
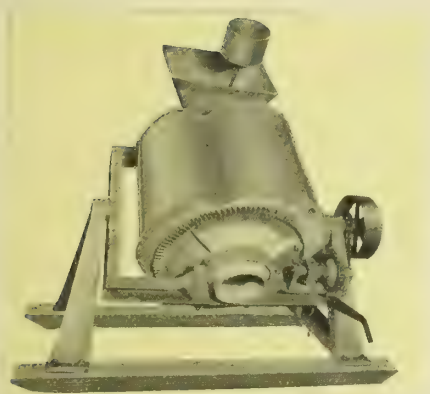
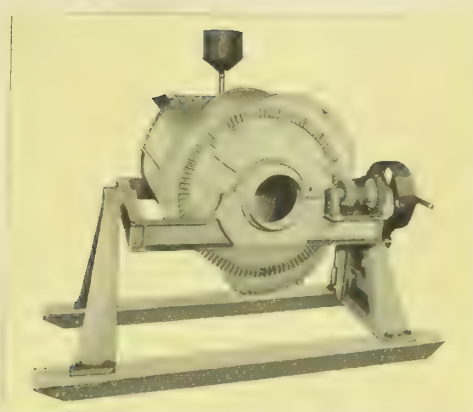




steel drum, the cross-section of which is shaped somewhat like a clover leaf. As shown in Plate 23, page 68, there are no inside parts whatever. By a bevel-gear at one end the drum is connected to the main driving shaft and is thus revolved. The frame upon which it rests is also pivoted at the sides in such a way that the drum while revolving oscillates in a direction at right angles to the axis of revolution. The materials are fed into the mixer through the receiving hopper shown in Plate 23, and the concrete is discharged through a circular opening at the opposite end of the drum. This latter operation is accomplished by tipping the drum as shown in Plate 23.

During the mixing process, the aggregate is constantly being thrown back upon itself on account of the peculiar shape of the drum. At the same time the oscillations





*The Clover Leaf Mixer*



tend still further to incorporate the mass. The different positions assumed by the particles of the aggregate are indicated by the diagram in Plate 23. Table 7 gives the principal facts about the different sizes of the Clover Leaf mixer.

Table 7  
Clover Leaf Concrete Mixers

Size	Horse-power Required	Capacity Cu. Ft. per Batch	List Price Without Power
1	2.0	4.5	\$ 200.0
2	3.5	6.5	240.0
3	5.0	8.5	285.0
4	8.0	11.0	325.0

## TYPE 8 - PUG-MILL MIXERS

It is to this type of machine that most of the continuous mixers belong. The one thing common to all mixers of this type is a system of blades revolving in a stationary horizontal trough. This device, being somewhat similar to that used for mixing brick clay, no doubt gives rise to the name. One of the noticeable features of these machines



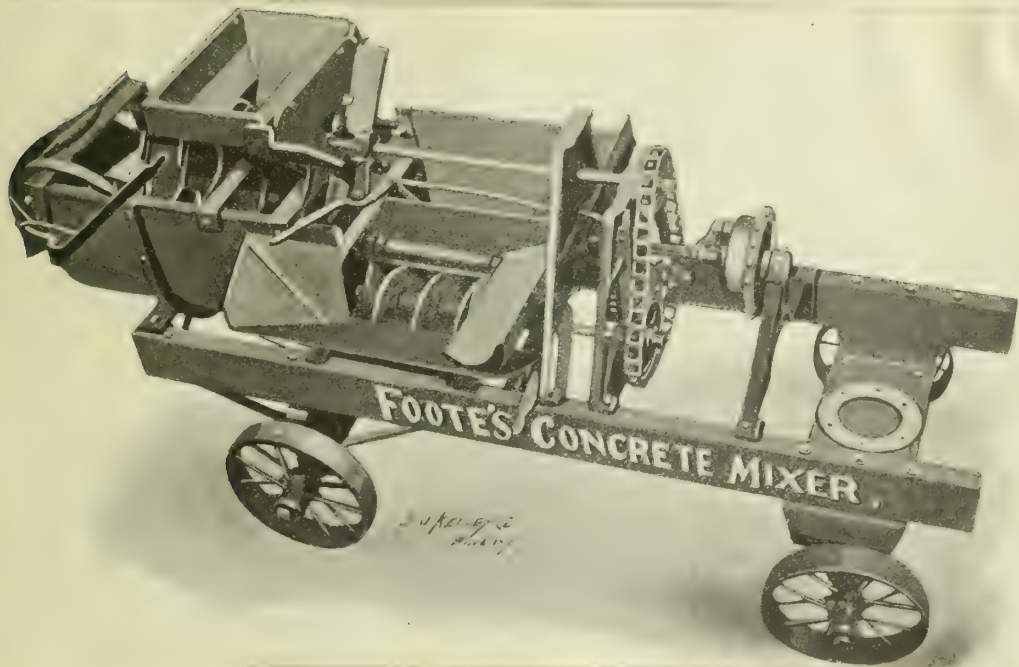


is the large number of automatic feeding and measuring devices employed. The capacity of these mixers is as a rule very large.

### The Foote Mixer

This is a continuous machine which can also be operated as a batch mixer. The construction is as follows: The receptacle for the concrete is a steel trough of semi-circular cross-section through the center of which runs a shaft to which are attached twenty four blades set in rows of six each, as shown in Plate 24, page 71. On one side of the mixing trough is a hopper for receiving sand, on the other side one for gravel or stone, and above is the cement hopper. In the bottom of each hopper is a large screw, which when revolving draws out the material from above and forces it into the mixing trough—see Plate 24. By means of different





The Foote Mixer





sized gear wheels these screws can be operated at different speeds. In this way the sand, cement, and stone can be automatically fed into the mixing trough in any proportions desired. Water is supplied by a spray-pipe from a tank on the front of the machine. A lever is so arranged that the supply of materials can be cut off at any time.

At the discharging end of the trough is a drop-gate which is raised and lowered with a lever. It is usually kept raised except when discharging the concrete into wheelbarrows; in which case it is alternately raised and lowered. When the machine is used as a batch mixer the gate is closed, the supply cut off after the trough is full, and the batch mixed for the specified time.

The advantages of this machine are its large capacity, and the automatic measuring device.



a disadvantage is the complicated nature of the mechanism, making it necessary to have a skilled man as operator.

During the fall of 1905, the writer spent some time observing a Foote mixer which was engaged in putting in pavement foundations at Urbana, Ill. Sixteen men were employed as follows: one operating the drop-gate, one feeding cement, four feeding sand, five feeding rock, four wheeling away the concrete, and one tending the loading of the wheelbarrows. The sand and crushed rock were placed in piles on each side of the pavement so that the men could shovel directly into the hoppers. The measuring device was set for 1 part cement, 6 parts rock and 6 parts sand.

The progress made by this mixer was 70 sq. yds. of 6 inch concrete in one hour (a rate of 14 cu. yds per hour). The contractor





and the inspector both seemed satisfied with the result.

This machine is manufactured by the Foote Manufacturing Company of Munda, N. Y. The principal facts about each of the various sizes are given in Table 8.

Table 8  
Foote Concrete Mixers

Size	Horse-power Required	Capacity Cu. Yd. per Hr.	List Price Without Power	
			On Skids	On Truck
1	5	5.5	\$490.0	\$525.0
2	5	6.5	590.0	625.0
3	9	16.0	1025.0	1075.0
4	12	22.5	1150.0	1200.0

### The Drake Continuous Mixers

The Drake Standard Machine Works of Chicago manufacture these mixers in a great many different forms and sizes. However, they all employ the same method of mixing - a system of knives revolving in a stationary trough. Under the name of Duplex No. 1, the manufacturers include all of

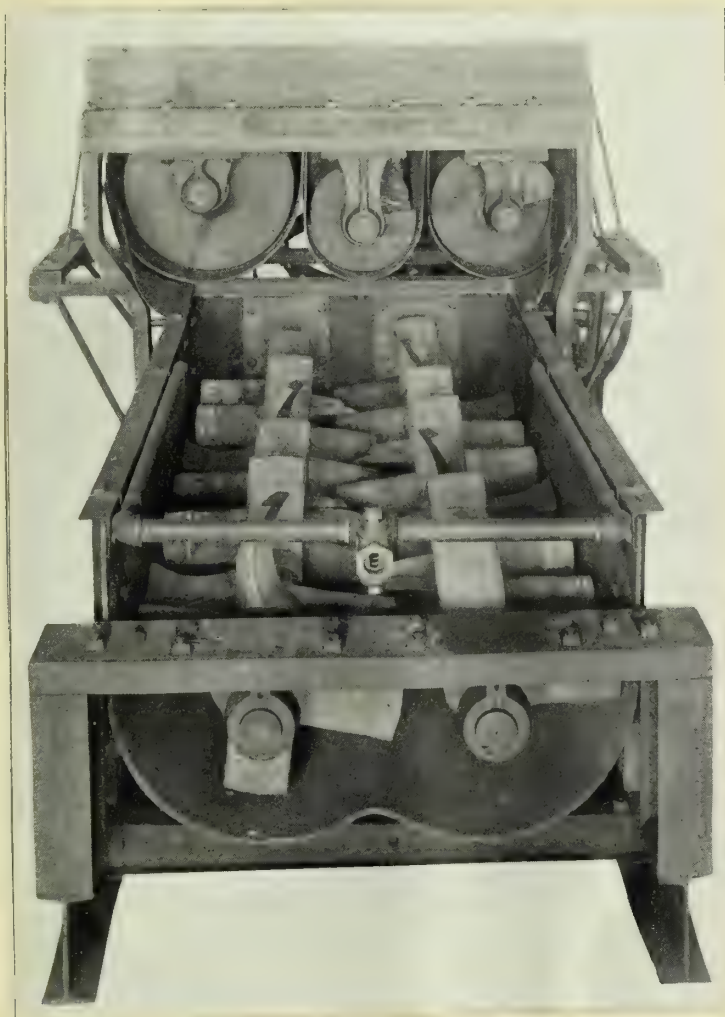
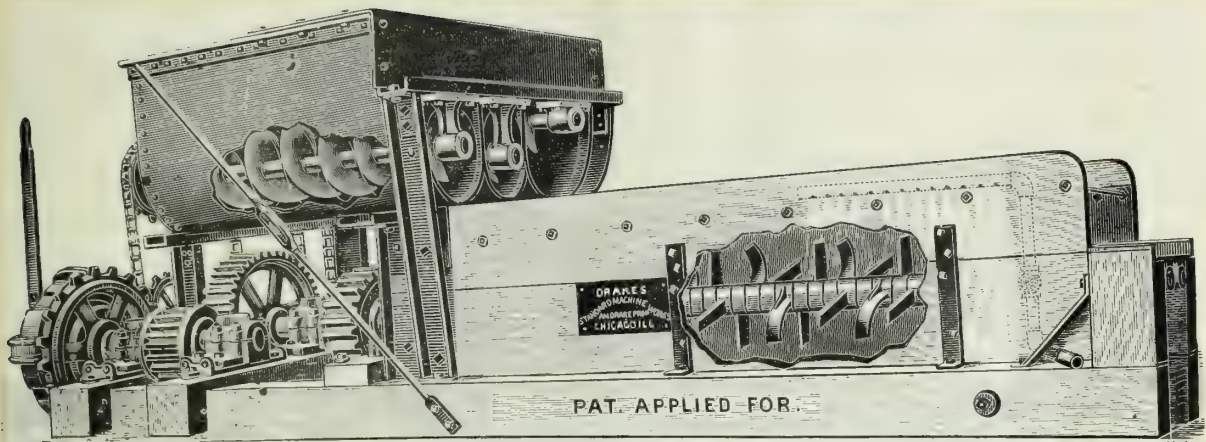




their machines which have a double system of revolving knives, while under the Nos. 2, 3, and 4 they include all mixers which have a single system of revolving knives. Each of these general classes itself includes several machines which differ as to size, and methods of feeding and discharging according to the peculiar conditions which they are intended to meet.

All Duplex No. 1 machines have the following fundamental construction: The concrete is mixed by two sets of revolving knives which operate side by side in a stationary trough. These knives are placed alternately with their edges and with their flat sides turned up; the object of such an arrangement being to turn the mass over and over while "cutting" it. To better understand this arrangement see Plate 25, page 76. Power is transmitted to the machine





*Duplex No. 1 Drake Mixer*





either by direct or bevel gearing. Materials may be fed into the mixer in their proper proportions either by the automatic screw device shown in Plate 25, page 76, or by alternately filling and emptying two hoppers with the previously proportioned materials. The methods of discharging the concrete vary greatly and will be treated under the different kinds of duplex machines.

For heavy work the mixer shown in Plate 26, page 78, is used. It is mounted on a car and has a conveyor for delivering concrete at some distance from the machine. The materials are in the cars back of the mixer and are brought to the receiving hopper in wheelbarrows along the elevated run-way. The engine which operates the machine is powerful enough to move the train of cars back and forth when necessary. The mixer shown in Plate 26 is engaged





*Duplex No. 1 Drake Mixer*





on a large retaining wall along the tracks of the Western Indiana R.R. in Chicago. The capacity of this machine is 40 cu. yds. per hour, the horse-power necessary for operation is 20, and the list price including power is \$3650.

The Duplex No. 1 mixer shown in Plate 25, page 76, is specially adapted to stationary work. It has the automatic feeding and measuring device, the screws revolving in the separate hoppers as shown. By attaching different sprocket wheels to the screw shafts, each screw can be operated at several different speeds and thus the materials can be fed into the mixing trough in various proportions. The capacity of this mixer is 40 cu. yds. per hour, a 20 horsepower engine is necessary for operation, and the list price without power is \$1100.

As previously stated, the mixers which are numbered 2, 3, 4, and 5





differ from the Duplex No. 1 machines chiefly in the fact that they have a single instead of a double system of revolving knives. They are also built in smaller sizes and are meant for lighter work. In respect to the power used, methods of transmitting the same, and methods of feeding and discharging these mixers are similar to the Duplex No. 1 machines.

A No. 2 mixer is shown in Plate 27, page 81. It is mounted on trucks and is specially adapted to street paving work. A swinging conveyor delivers the concrete where needed, and another conveyor delivers the materials to the receiving hopper. This machine does not, however, have the automatic feeding and measuring device. The mixer can move by its own traction. Its capacity is 150 sq. yds. of 6 inch concrete per hour (25 cu. yds.), and the list price including a 20 horsepower engine





No. 2 Drake Mixer



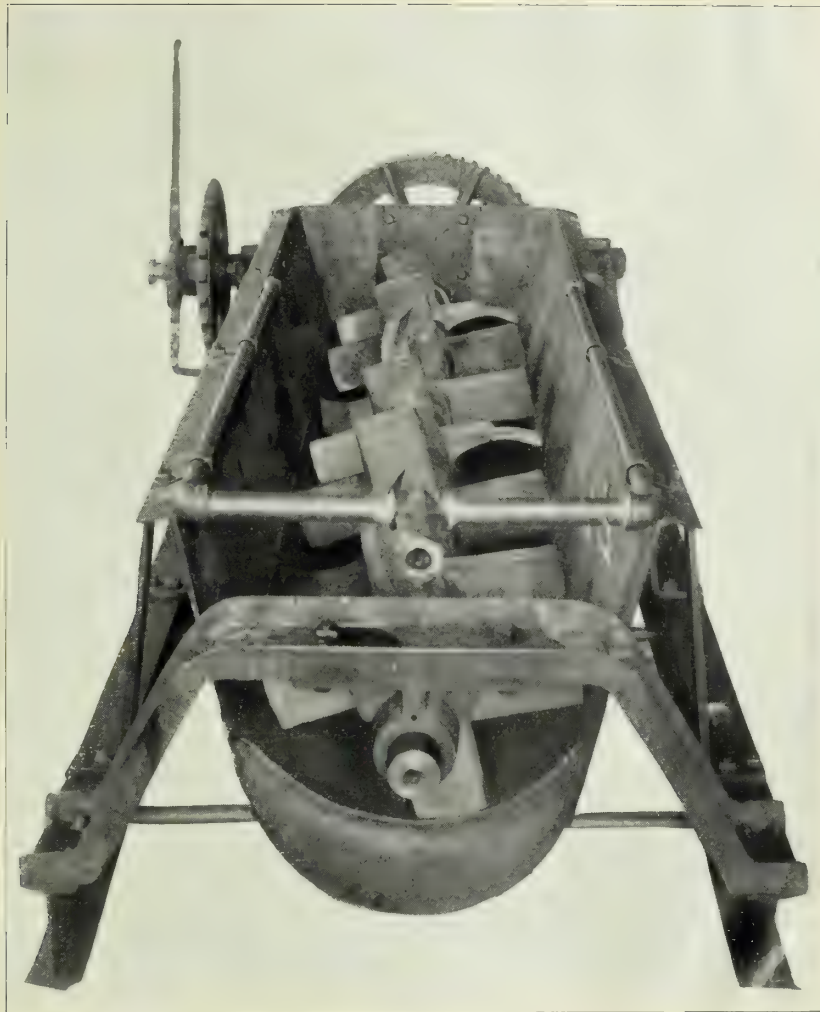


is \$3600.

A very simple No. 2 Drake mixer, shown in Plate 28, page 83, is intended for stationary work. The materials are proportioned by hand and shoveled into the mixing trough. The end-gate shown can be raised by a lever when discharging concrete. Power is transmitted to the mixer by a bevel gear. The capacity is 20 cu. yds. per hour, the horsepower required for operation is 10, and the list price, without power, is \$350.

The writer saw a machine of this type but of a smaller size in operation at Bloomington, Ill., during the construction of a reinforced concrete reservoir. The output was averaging  $7\frac{1}{2}$  cu. yds. per hour. Twelve men were employed as follows: four shoveling materials into the mixing trough, two shoveling the concrete into wheelbarrows, six handling the wheelbarrows, and one operating the engine. The





*No. 2 Drake Mixer*



contractor stated that he had used the machine for several months, and that it had given good satisfaction.

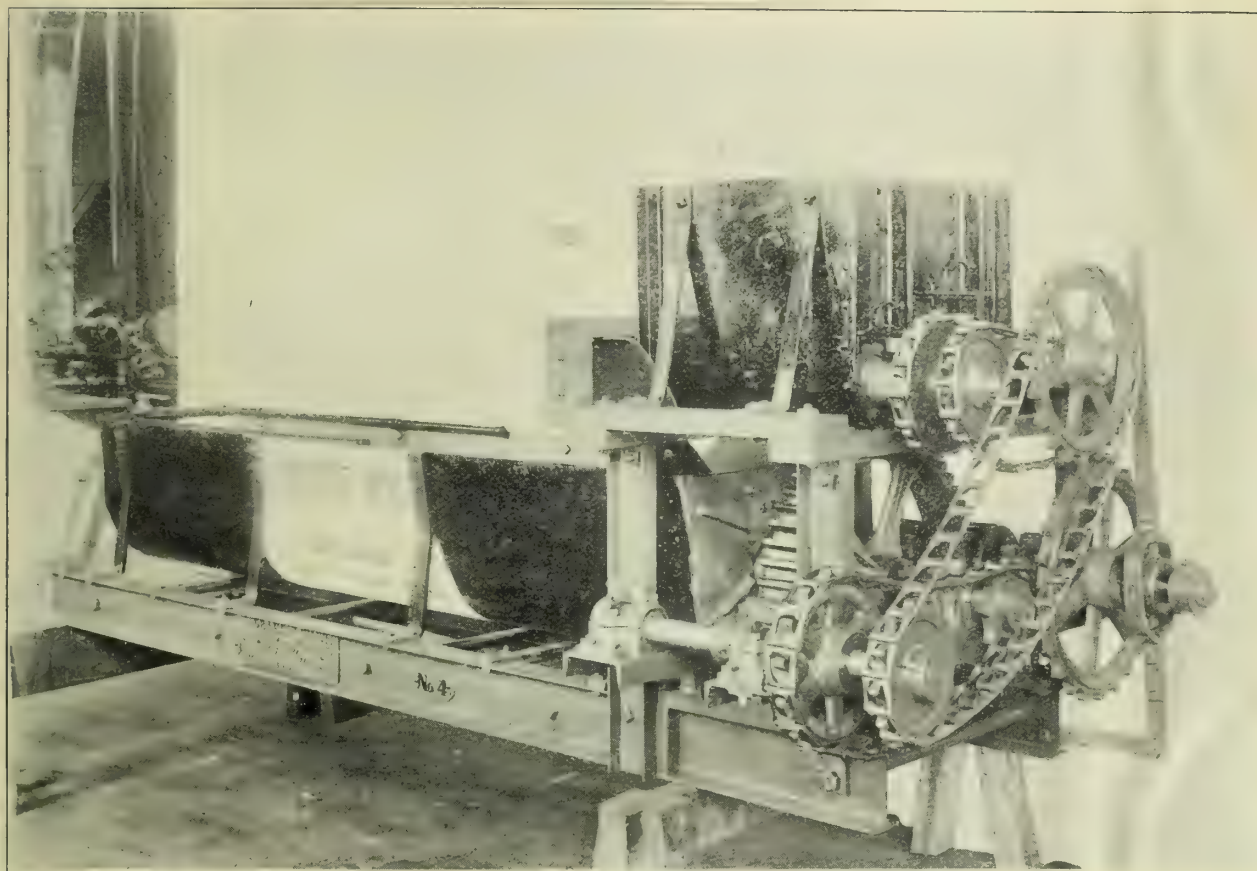
A No. 4 Drake mixer is shown in Plate 29, page 85. It is equipped with the automatic feeding device previously described on page 79. The arrangement of the sprocket wheels, controlling the speed of the feeding screws, is clearly shown. This machine is intended for stationary work. The capacity is  $7\frac{1}{2}$  cu. yds. per hour, the horse-power required is 8, and the list price without power is \$550

### The Connolly Mixer

This is a continuous mixer, manufactured by the United States Concrete Machine Company of Detroit, Mich. The mixing of the concrete is accomplished by a number of blades revolving in a stationary trough—in a manner very much like the other mixers of this type, as shown in







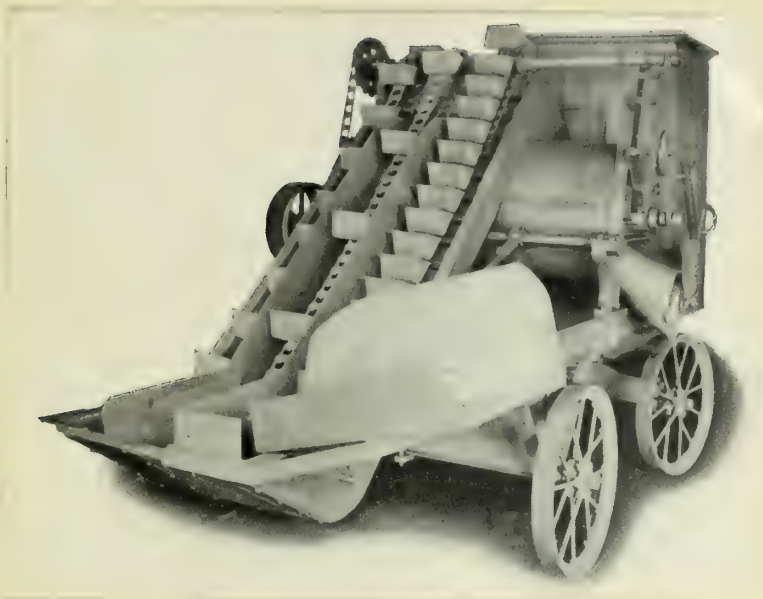
*No. 4 Drake Mixer*



Plate 30, page 87, the unique feature of the machine is the automatic proportioning device. Three hoppers—one for cement, one for sand, and one for crushed rock—are placed side by side in a position close to the ground. Beneath each hopper passes an endless chain conveyor, which catches the material and carries it to the mixing trough above. The buckets of these conveyors are detachable and it is by means of this arrangement that the automatic proportioning is accomplished. For instance, if a proportion of one part cement to two parts sand and four parts rock is desired, eight buckets are attached to the cement conveyor, sixteen to the sand conveyor and thirty two to the rock conveyor. Since the buckets are of uniform size and move at the same speed, it can be readily seen that automatic proportioning can be accomplished by this arrangement.







*The Connolly Mixer*



The three materials enter the mixing trough continuously, where they are mixed dry for one half the length of the trough. Water is then sprayed upon the aggregate and the remainder of the mixing is wet. The concrete is discharged continuously from a spout at the end of the mixing trough. A drop-gate controlled by a lever is so arranged that the discharge can be temporarily cut off at any moment. Power is supplied by a gasoline engine enclosed as shown in Plate 29.

An advantage of the Connolly machine is the very low, and therefore convenient position of the feed hoppers. A disadvantage is the enclosed mixing trough, which causes the mixture to be hidden from the eye of the operator.

Table 9 gives the power required, the capacities, and the list prices of the two sizes of this mixer.



Table 9  
Connolly Concrete Mixers

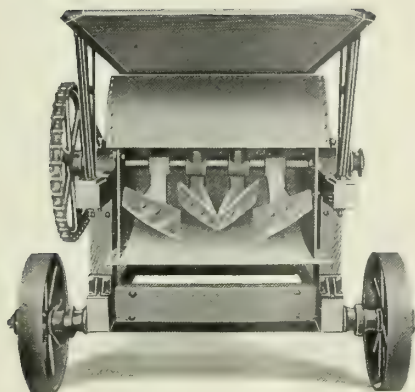
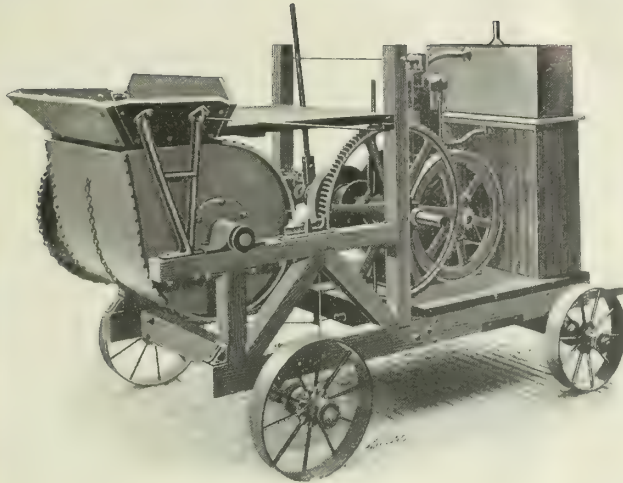
Size	Horse-power Required	Capacity Cu. Yd. per Hr.	List Price With Power
1	6	12.5	\$1050.0
2	8	17.5	1250.0

### The American Mixer

This machine is a batch mixer and is manufactured by the International Fence and Fireproofing Company of Columbus, Ohio. The concrete is mixed in a steel drum which does not itself revolve but within which is a system of revolving blades attached to a horizontal axis. A single opening in the top of the drum serves both for receiving and discharging a batch. During the mixing process the drum is in the upright position, as shown in Plate 31, page 90. When discharging, the drum can by means of a lever be tilted down and thus the concrete is allowed to slide out of the machine. This operation is rendered much more expeditious by the blades, which continue







*The American Mixer*



to revolve, thus scooping out any material that may stick to the sides. As soon as emptied, the drum returns automatically to its upright position.

On a level with the top of the drum is a platform upon which the operator of the machine stands. In this position he can control the operating levers and at the same time keep an eye on the mixing. This mixer is mounted either on skids or trucks and is made in four sizes. Table 10, page 92, gives the principal facts about each size.

Two advantages of the American machine can be named: (1) the mixing is in plain sight; (2) the drum is thoroughly cleaned during the discharging process by the revolution of the mixing blades.





Table 10  
American Concrete Mixers

Size	Horse-power Required	Capacity Cu. Ft. per Batch	Capacity Cu. Yd. per Hr.	List Price - Without Power	
				On Skids	On Truck
1	3	7	6	\$ 350.0	\$ 375.0
2	4	9	10	425.0	455.0
3	4	14	16	500.0	535.0
4	6	18	21	600.0	640.0

### The Trump Mixer

This machine - so called from the name of its inventor - is manufactured by the Link-Belt Engineering Company of Philadelphia. Its distinctive feature is the ingenious device employed for automatically proportioning and mastering the materials. As shown in Plate 32, page 93, three troughs carry the materials from the hoppers above (for arrangement of hoppers see Plate 34, page 97). The materials pass from the troughs into three concentric hollow cylinders, and thence to three revolving disks which are placed beneath the cylinders and one above the other. At the edge



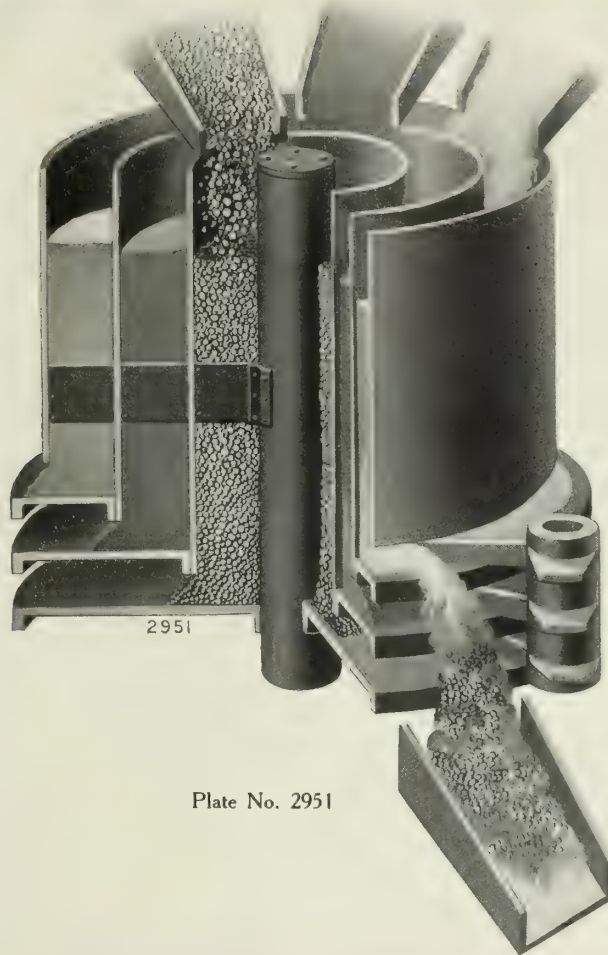


Plate No. 2951

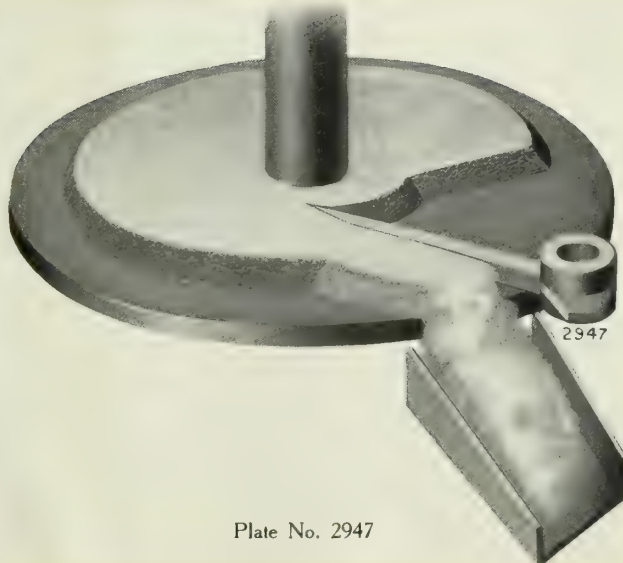


Plate No. 2947

*The Trump Mixer*



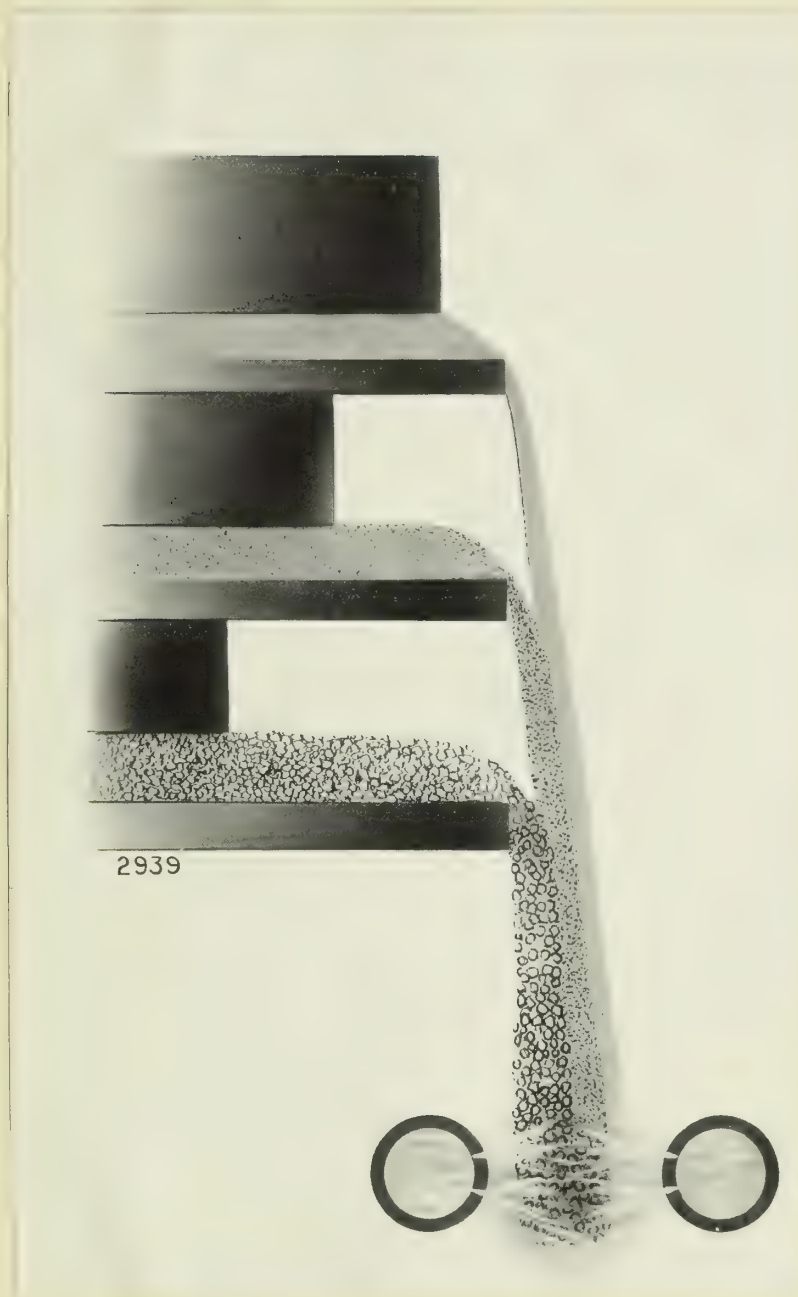
of each disk is a stationary knife, which can be so adjusted as to "heel" off, at each revolution of the disk, a certain amount of the material. In this way the concrete can be made of any proportions desired.

The moistening device is shown in Plate 33, page 95. As illustrated there, the sand rock and cement, after being measured, fall between two perforated water pipes. The advantage claimed for this method of moistening the concrete is that the materials while thus falling in thin sheets are more thoroughly penetrated by the water jets.

After being moistened the mass drops into a trough where it is mixed by a system of revolving knives in a manner similar to other mixers of the pug-mill type. The supply of materials from the receiving hoppers can at any time be shut off by means of a lever. Another lever controls a drop-gate at the end







*The Trump Mixer*

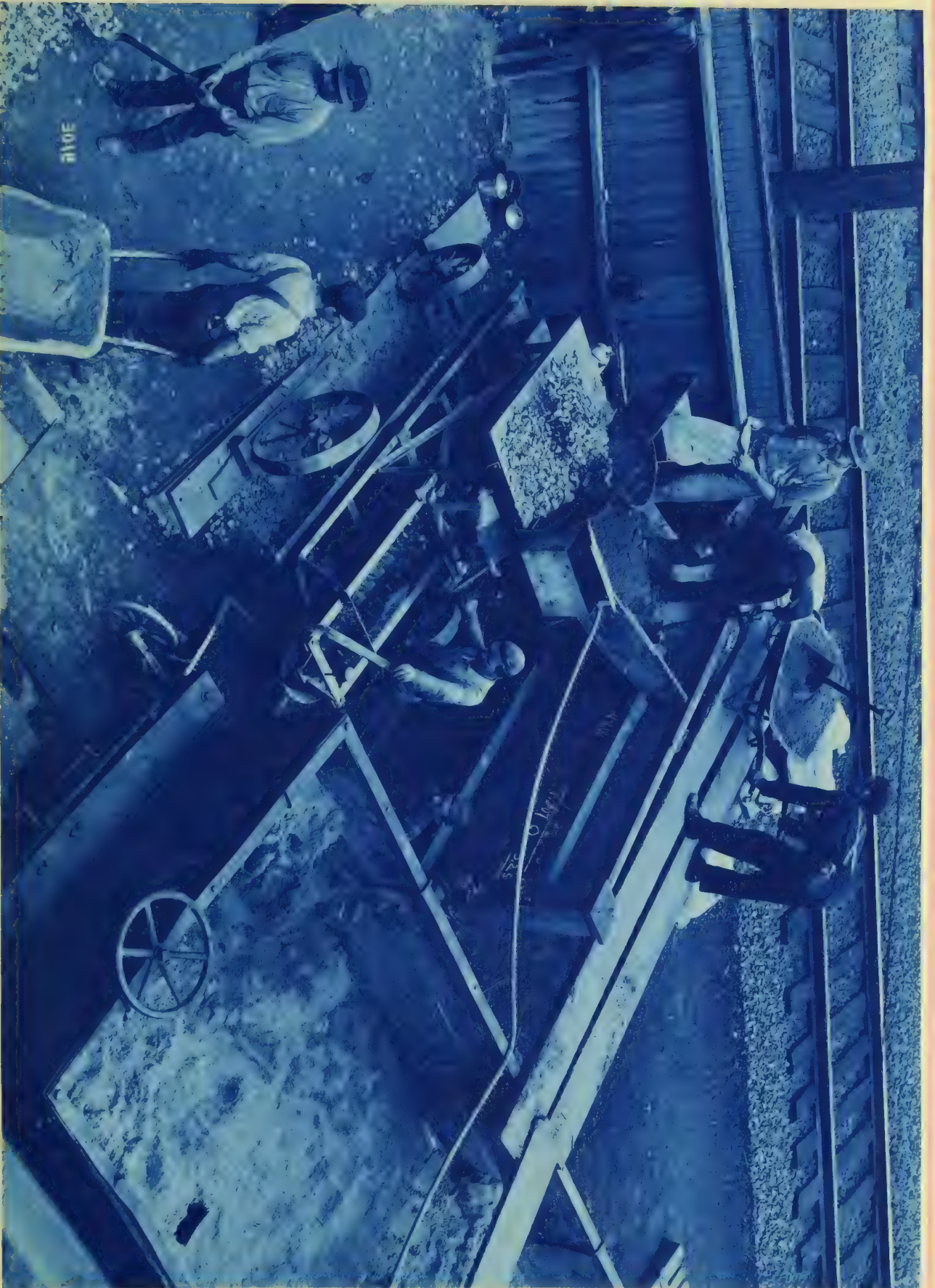


of the mixing trough and thus regulate the discharge. In Plate 36, page , the operator is shown with his left hand on the discharging lever and his right hand on the lever governing the supply from the hoppers.

The Trump machine is made in two sizes. In Plates 34 and 35, pages 97 and 98, is shown a mixer having a capacity of seven cubic yards of concrete per hour. The list price is \$1075 without power. The mixer shown in Plates 36 and 37, pages 99 and 100, has a capacity of fifty cubic yards per hour. Its list price is \$2200 without power. This machine is equipped with a conveyor for carrying the materials from the ground to the hoppers.







The Trump Mixer - Small Size



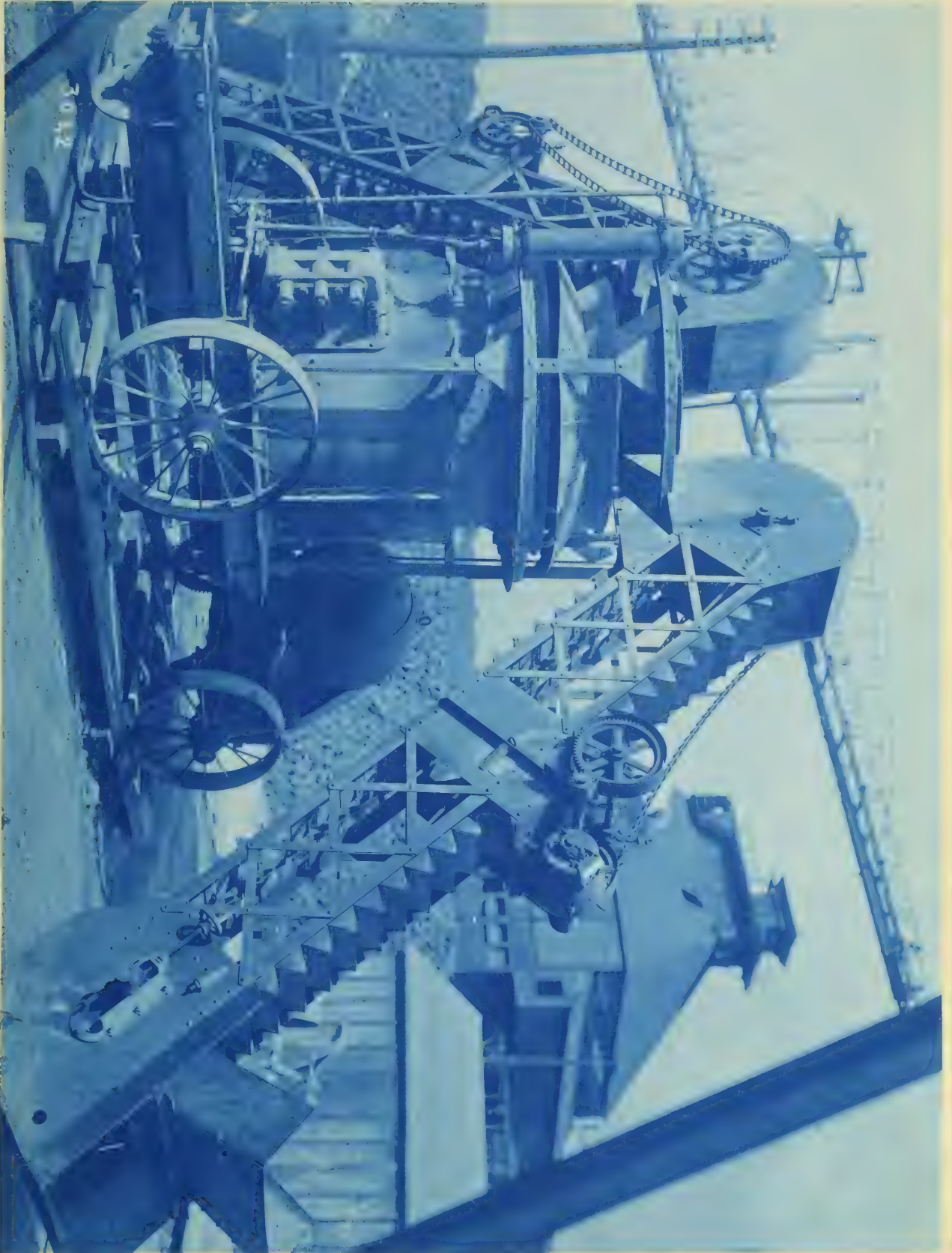


*The Trump Mixer - Small Size*









*The Trump Mixer - Large Size*



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*The Trump Mixer - Large Size*



## CONCLUSION

After examining the various types of concrete mixers the query naturally arises - What is the best type of machine? As a result of his investigation of this question the writer has arrived at the following conclusions.

In the first place there are so many different conditions to be met with in concrete mixing that it would be too arbitrary to name any certain machine as being the best. Then the handling of a mixer must be taken into consideration. Indifferent handling of a good machine may cause the concrete to be poorer in quality than that mixed by an inferior machine properly manipulated.

But leaving peculiar conditions out of consideration, it may safely be said that a batch mixer produces a better grade of concrete





than a continuous machine. In operating the former, the batch, having been measured is placed in the machine and mixed as a unit, without either the loss or addition of materials during the process. On the other hand, with the continuous machine the constant influx and discharge of materials must surely at times cause irregularity in the mixture due to the different speeds at which the particles of the aggregate pass through the mixer.

The three best types of batch mixers are probably the inclined drum, horizontal drum, and cubical machines. The cubical mixer is thorough in its operation but the feed and discharge are usually awkward, and the mixing is for the most part concealed from the eye of the operator. The horizontal drum machine is as thorough in its work as the cubical, and has



a more convenient method of feeding and discharging. The mixing however is also partly concealed. The inclined drum mixer does the mixing more thoroughly than the horizontal drum machine, due to the constant rolling of the particles over one another by reason of the inclination. The feeding and discharging are also convenient and the mixing is always in plain sight of the operator. In view of these facts the inclined drum mixer is probably the best batch machine now in use.

While the continuous mixer does not produce as high grade a concrete as the batch machine, this mixer still has its legitimate use. It is the best machine to use on work where a large output of concrete is demanded without special stress being placed on the excellence of the product. For example, foundations for street pavements can be advantageously





placed by the use of continuous machines.

The best type of continuous mixer is without doubt the pug-mill type. For the system of revolving blades used in such a machine tends to keep the aggregate moving forward at a uniform rate during the mixing. The revolving drum mixer, as previously noted, is also used as a continuous machine but with poor success. The reason for its failure as such is that the deflecting blades attached to the inside of the drum cannot move the aggregate forward at a uniform speed during the mixing. As a result the concrete issuing from such a machine is frequently too dry or too wet.

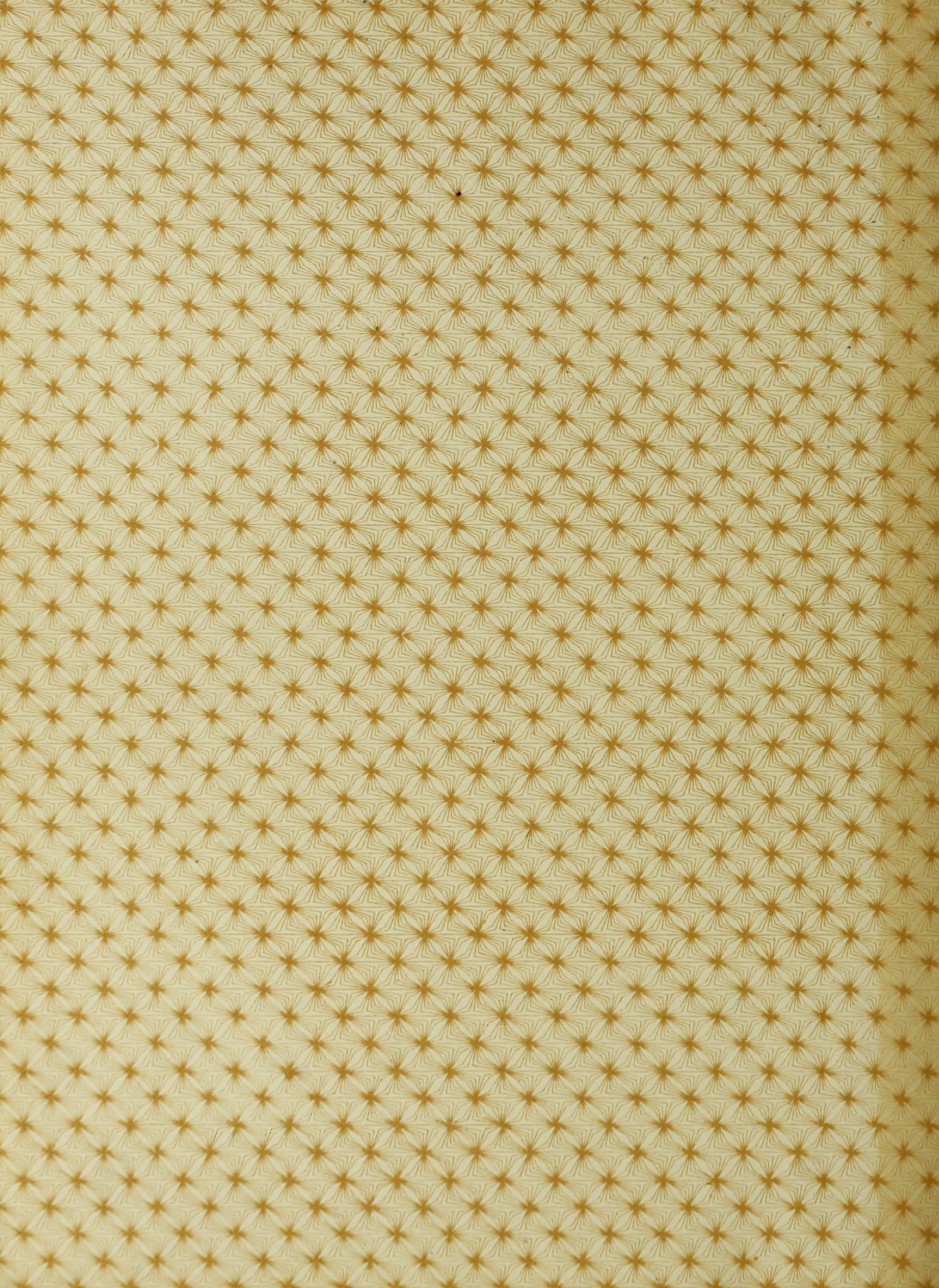
The future development of concrete mixers will probably consist chiefly in advancing the continuous machines by perfecting the automatic feeding and measuring devices. A good start has already been made



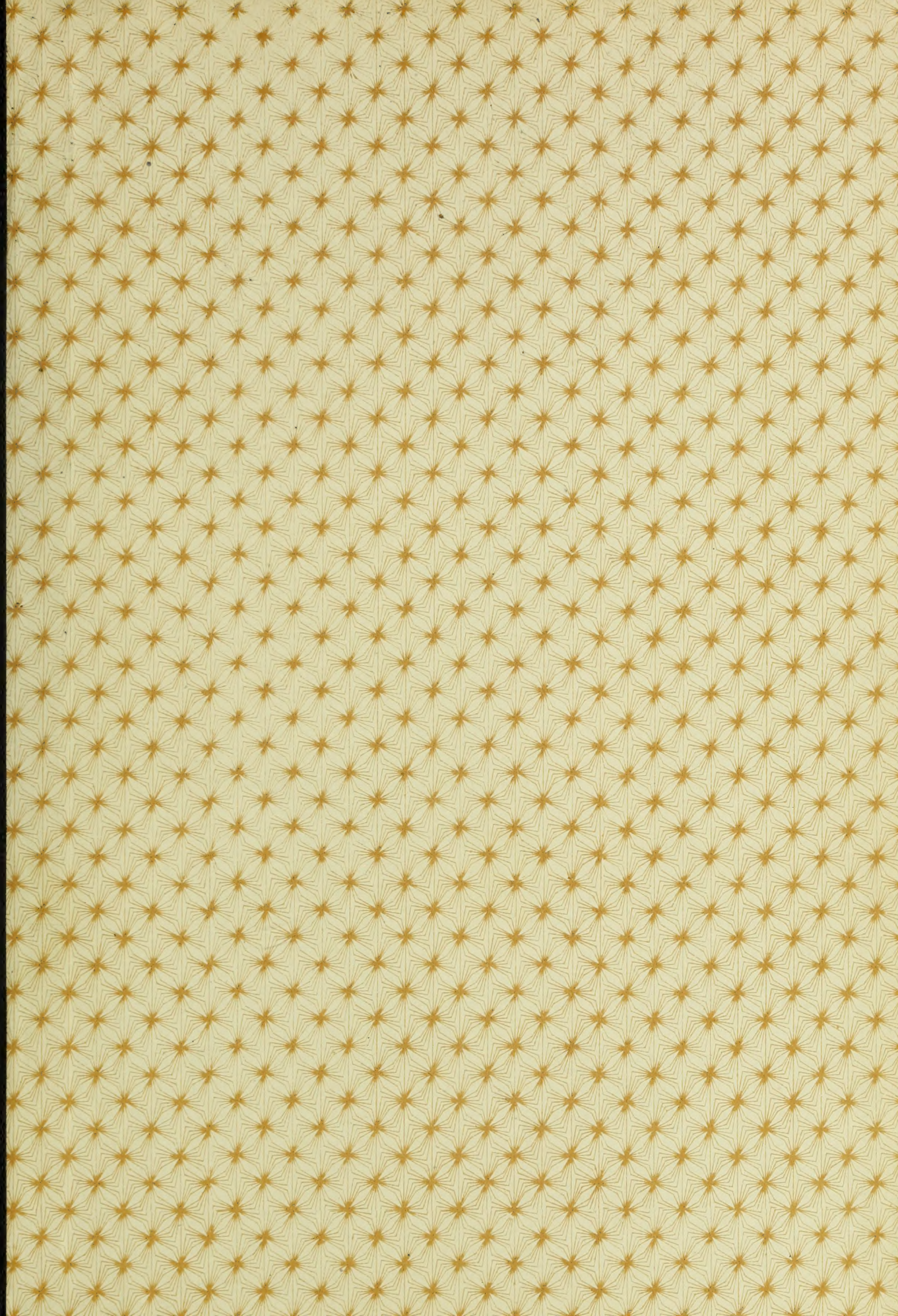


in this direction but there is still  
much room for improvement.











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